SPOT
THE MISTAKES!
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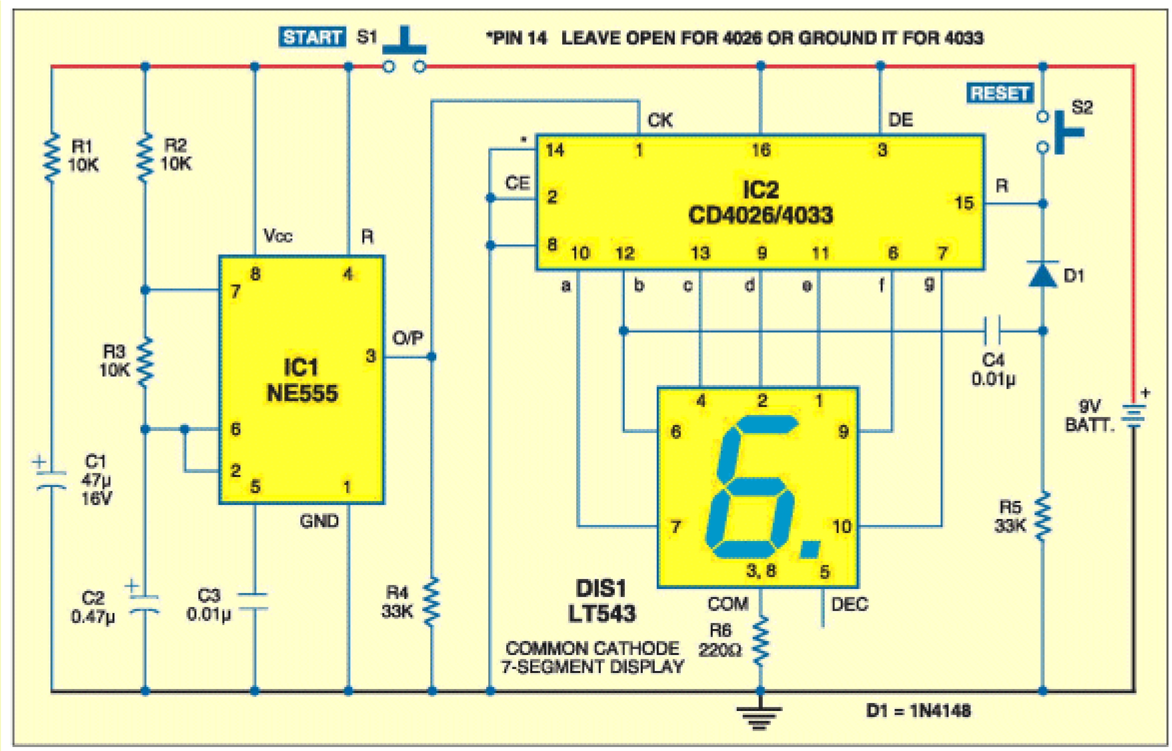
The whole purpose of Talking Electronics website is to teach electronics without introducing any technical details. It's pointless knowing how much doping is required to produce a zener diode, if you don't know how to connect it to a circuit.
I have seen so many faulty designs in an Indian magazine: **Electronics For You,** from writers who have a list of qualifications after their name, that it makes their degree in electronics questionable.
I know no-one likes to be criticized but when you are teaching **how to design a circuit**, it is important the circuit not only works, but is designed correctly.
It is not good enough for a circuit to work, it must be designed correctly so it takes the least current and requires the least number of components. Every component has a "technically correct" value for each position in a circuit and that's what we teach. When the component-values are outside this range, it is obvious the engineer is lacking the skills in circuit-design. However if the circuit specifically requires a certain value, mention it on the diagram.
That's what a circuit is for. It MUST show all the values of all the components. It's a stupid idea to have a List Of Materials. Only an IDIOT would draw a circuit with R1, R2 etc and provide a list of values. He obviously have absolutely no electronics ability AT ALL. I can work out what a circuit is doing by looking at the component values. That's why this website is so important. It is teaching ELECTRONICS UNDERSTANDING.
The traffic to our site is increasing all the time and it has just reached 7,000 visitors per day.
This is spread over hundreds of articles, but the eBooks are getting most of the readers while those that are really interested in electronics are reading through the 14 pages of **Spot the Mistake.**
This type of teaching has never been done before, and I wish it was available when I stated in electronics.
You learn more from other's mistakes than a whole book of successful circuits.

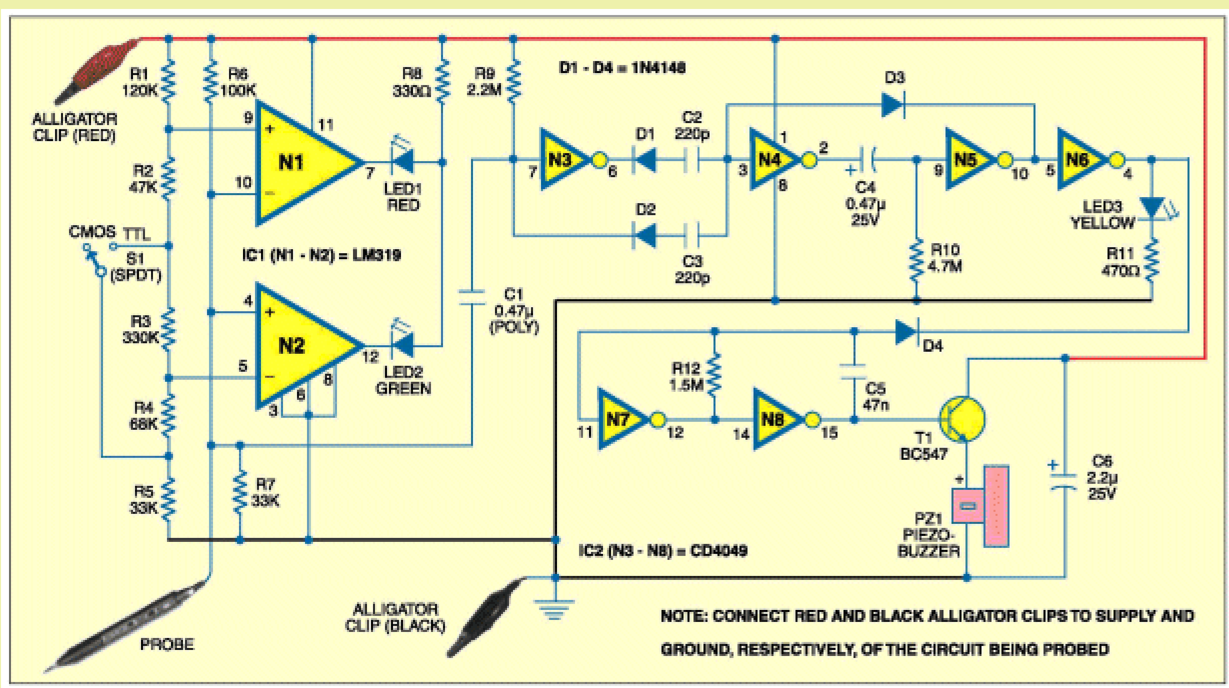
DICE

Electronics For You magazine is filled with mistakes and these will keep us busy for years to come.
Here is a DICE project with a number of mistakes:



The capacitor on pin 5 of the 555 is needed to keep the oscillations of the chip reliable. In this circuit we are requiring unreliability so the 10n capacitor is not needed.
A single resistor on the **common line** of the display will make the segments fade when a lot of segments are illuminated. To keep the segments equal-brightness, a resistor is needed on each drive-line.
The diode on the reset line serves no purpose. In fact it is creating a high impedance on the line and can cause a reset at any time. It should be removed.

Here we have a **CMOS/TTL LOGIC PROBE** from the Laboratories of **Electronics For You** Magazine:
It has lots of design-faults.



We start the discussion with Inverter N3. This is commonly called an **Inverter** or **NOT-gate**.
The input is sitting HIGH so the output will be LOW.

Only a HIGH-to-LOW transition on the input will change the state of the gate. This means the output will go HIGH.
It does not matter what voltage is on the anode of Diode D1, any rise in voltage on the cathode is not passed through the diode. That's not how a diode works. The diode is around the wrong way.
Now let's look at Diode D3. The input of N5 is LOW so the output is HIGH. No current can flow through the diode to the input of N4 and thus this inverter sits with an unknown voltage on the input.
Now let's look at the yellow LED. To turn on the pulse LED (yellow), the output of N6 must go HIGH. The input to N6 must go LOW and this means the input to N5 must go HIGH.
For the time-delay circuit (made up of C4 and R10) to work, Pin2 must be HIGH and C4 must be charged. Pin 2 goes LOW very briefly and the fully charged capacitor gets instantly discharged via pin 2 and the input protection diode on the input of N5. Pin 2 then goes HIGH and brings C4 HIGH and puts a HIGH on pin 9. This illuminates the yellow LED.
The capacitor gradually charges via the 4M7 resistor and this creates the delay.
But for this to happen, pin 3 of N4 must be LOW and if D1 is turned around the other way, pin 3 will be taken HIGH when a pulse is detected. D2 and C3 are not needed. A 4M7 is needed between pin3 and 0v rail and D3 is not needed.
This circuit is certainly a mess.

DING DONG DOORBELL

This circuit has a number of technical mistakes.
I have received a reply from **Electronics For You**, and the replies are in **red**. The reply was unsigned and the author of the circuit is unknown. Here is the datasheet for [BT8031-xx] that clearly shows the -02 version is Ding Dong. The sheet also shows the need for a buffer resistor on the output.

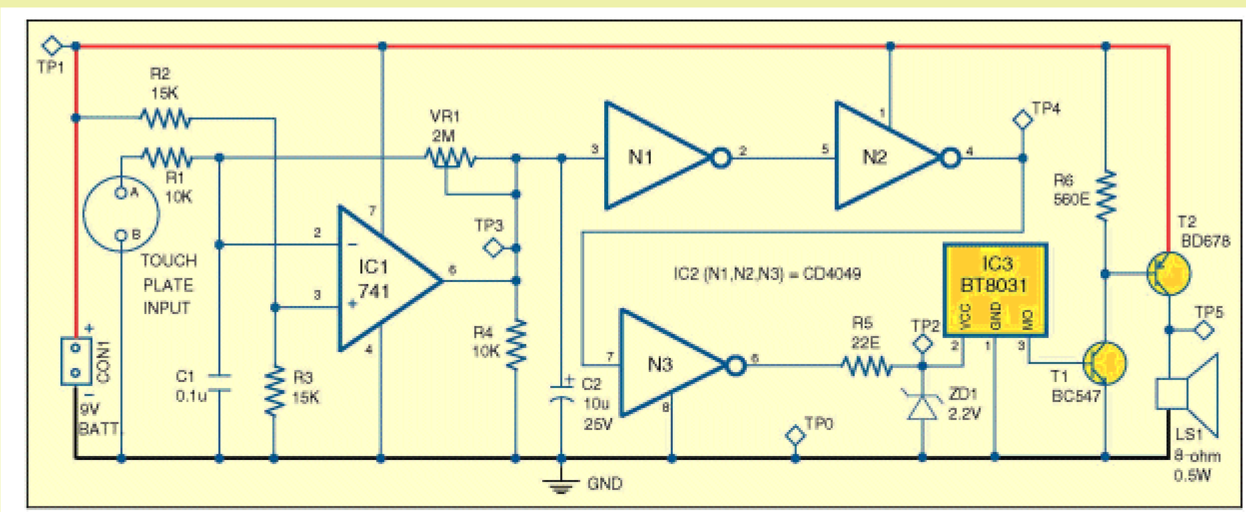


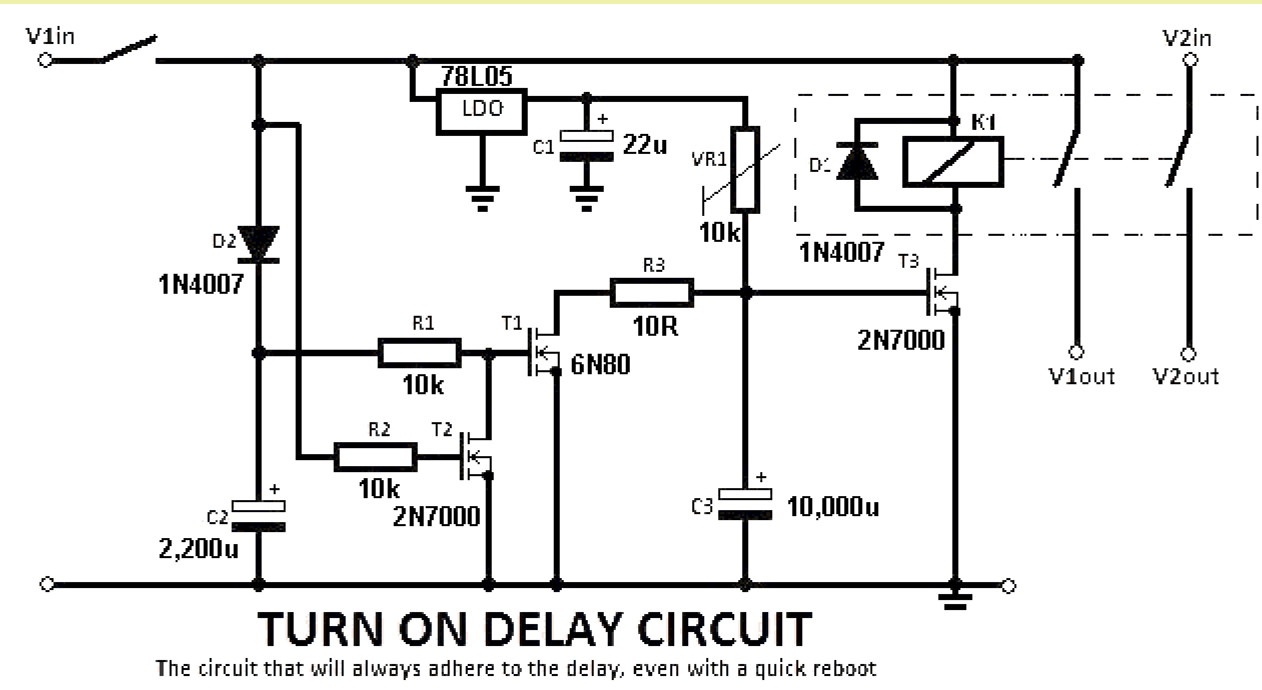
Fig. 1: Circuit of ding dong tone generator

The inputs to the NOT-gates are high impedance and the TOUCH PLATE could be connected to one of the inverters (NOT-gates) and this would eliminate the need for the 741 op-amp.
There are many ways to design the circuit to get the same output. This circuit shows the use of inverter and 741 op-amp - but a circuit should be as simple as possible - not as complex as possible.
The need for the 10k resistor (R1) is unknown. It serves NO purpose.
The need for the 10k resistor (R4) is unknown as the op-amp pulls low.
You will not know unless you wire and check yourself. What sort of answer is this?
Gates N2 and N3 are not needed as they simply produce the same result as the output of N1. Not in this case. N2 and N3 gates are needed, there are reasons behind it. What sort of answer is this?
The 22E (22R) resistor R5 is far too low. The CD4049 can source 10mA and to deliver this current to the 2v2 zener requires a 560R resistor. You have no idea why we use these values. Your doubt is based on theoretical observations. The reason why the resistor had to be so low was due to the absence of the buffer resistor on the output. One mistake led to another.
The output of the BT8031 requires a buffer resistor on the output of about 1k. The IC should not be connected directly to the base of a transistor. See the data sheet.
The output current of BT8031 is less than 2mA. You don't need a buffer resistor at its output pin in this design. We have the datasheet of BT8031. The data sheet clearly shows a 5k to 10k resistor on the output.
The BT8031 is actually BT8031-02 for the Ding Dong version.

OK you say so. We have not seen or used BT8031-02
The BD678 is actually a PNP Darlington transistor and should be drawn as a Darlington.
Normally we used transistors symbols either npn or pnp irrespective of Darlington or not. This SAVES time and space. But your point is noted.
The BC547 transistor is not needed as a PNP BD679 transistor could be used as the buffer transistor.
The BT8031-02 can be supplied with 3v and it may be necessary to deliver 3v to drive a Darlington transistor.
There is no current limiting resistor on the collector of the BC547. Without this resistor a very large current will flow through the junctions of the two transistors when driving the speaker and this is WASTED CURRENT.
The value of R6 is technically too low. It should be 10k.
Your doubt is based on theoretical observation. The design is working fine and no changes are required. The circuit may be "working fine" but it has so many technical faults that it is obvious the designer of the circuit has no technical ability AT ALL. This would be ok if he just produced the circuit for himself, but it is being presented in an electronics magazine for thousands of readers to study and observe and it should be technically correct.

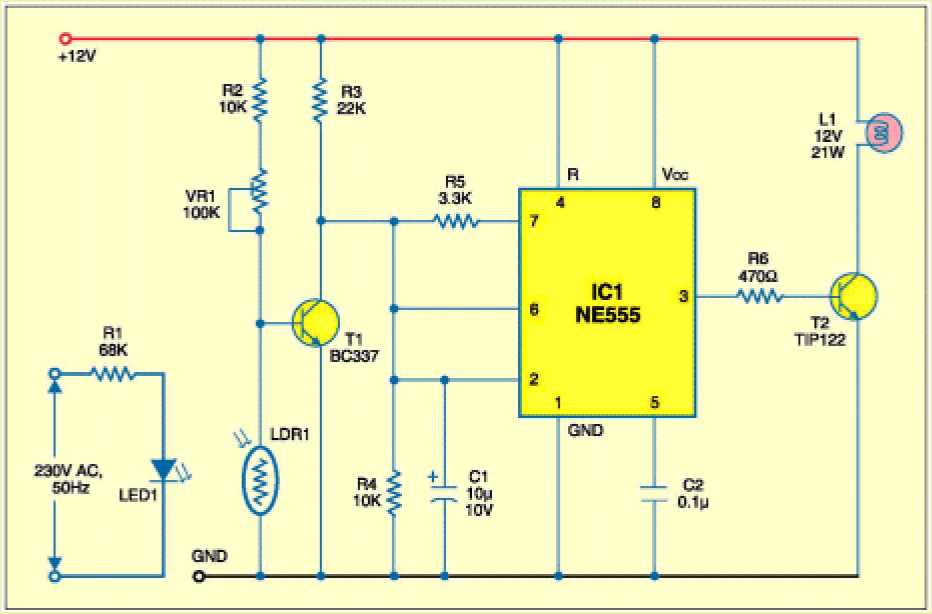
DELAY

This is one of the worst-designed Delay circuits:

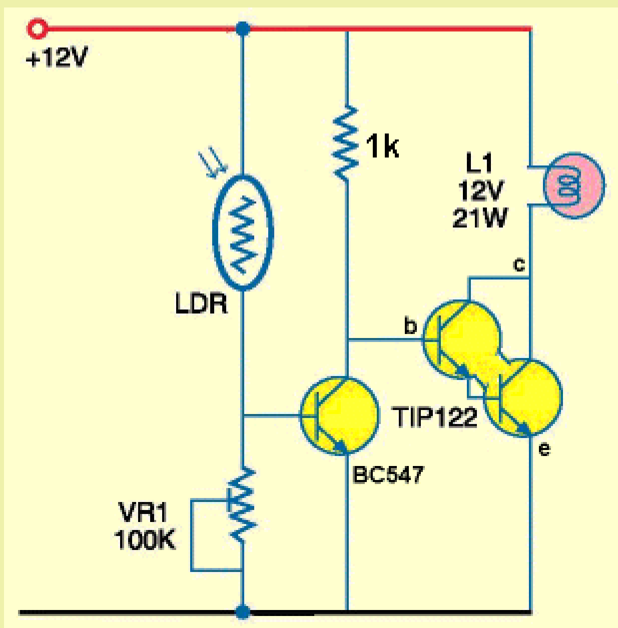


The circuit has been designed to discharge the delay capacitor when the circuit is turned off. This is a very unusual way to design, however if the connections to the gates of T1 and T2 are reversed, the discharging components will turn ON for a brief period and discharge the electro before the timing begins. A low-value resistor will need to be added in series with the 2,200 to generate the required time-delay.
The delay is made up of a 10k multi-turn pot and 10,000u electrolytic. Normally a delay is made up of a high resistance and low value capacitor. The mid-point of these two components is then taken to a high impedance detecting circuit. In this case it is the gate of a FET. The 10k should be increase to 100k or higher and then the capacitor can be reduced to 100u to 220u.
A muli-turn pot is the worst choice of pot as you don't know where the wiper is positioned. 10-turn pots are NOT designed to be constantly adjusted.
The 1N4007 diodes can be changed to 1N4004 to show that 1,000v diodes are not needed.
The value of R1 and R2 should be increased to 47k to show the surrounding circuit is high impedance.
The 78L05 is not a LDO (Low Drop Out) Regulator.
The designer of the circuit says "resistors of high values are less durable" What does this mean? If he means they are less reliable, it is not true. A 100k or 470k resistor is just as reliable as 10k.
The designer suggests a 3v3 regulator. The 2N7000 requires up to 3v to turn ON when 75mA is needed. If the relay needs 100mA or more, the gate may require slightly more than 3v and the circuit will not work.
The circuit is over-designed and uses expensive components.

Here is another over-designed circuit:



All that is required is two transistors:



The Darlington transistor provides a gain of more than 10,000 and the 1k resistor on the base will turn the TIP122 on hard enough to illuminate the 21watt globe. Don't forget, the globe will require 5 or more amps to start glowing as the resistance of the filament is very low when the lamp is cold and that's why it takes up to 6 times more current.

Here's another over-designed circuit with mistakes:

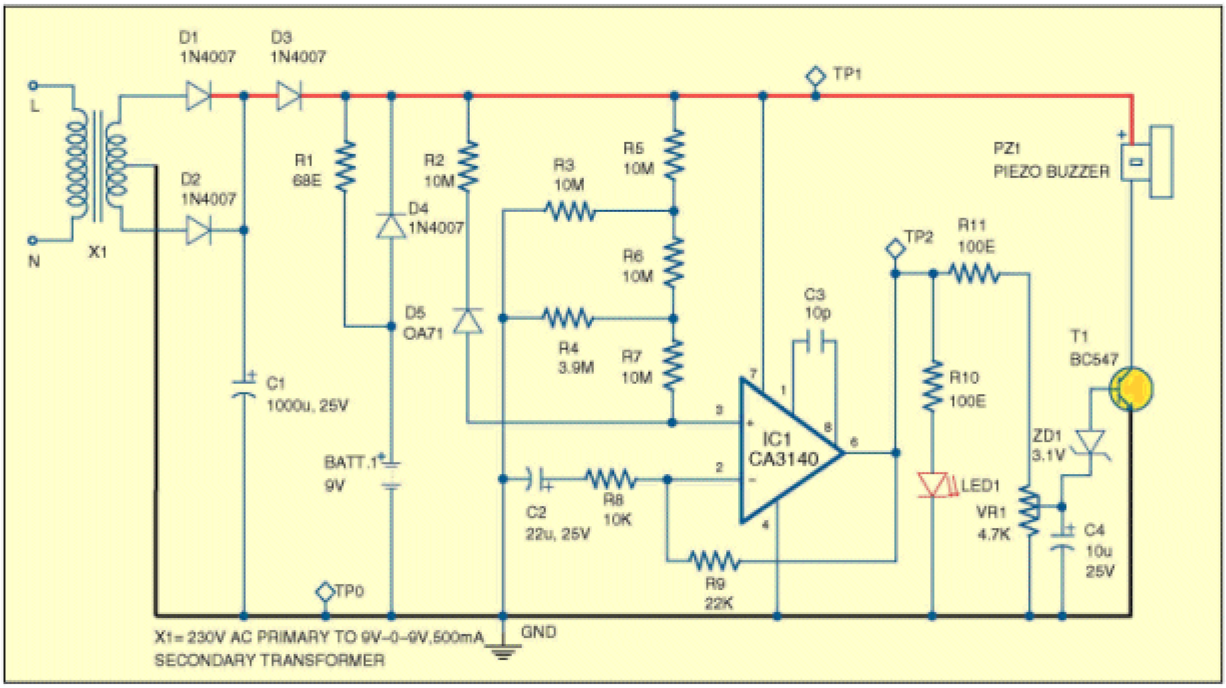


Fig. 1: Circuit of signal diode based fire sensor

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1. What is the purpose of D3?   It is not needed. The battery cannot feed-back into the power supply as diodes D1 and D2 will block the voltage.
2. D1, D2 and D4 should be identified as 1N4002 to indicate the reverse-voltage only needs to be 100v. A 1N4007 is a 1,000v diode.
3. The output of a 9v - 0v -9v transformer will be a lot higher than 9v on NO LOAD due to the poor regulation of these types of transformer. The output voltage is designed to fall to 9v on full load. This means supply rail will be a lot higher than 12v and the 9v battery will be overcharged via the 68 ohm resistor.
4. R3 R4 and R6 can be converted to a single resistor.
5. You cannot drive a diode through a 10M resistor and expect to get a result. Any voltage-change will be partially or wholly absorbed by the 10M resistor.
6. What does C2 and R8 do? There is nothing at the join of these two components and they perform no function when connected in series. This type of arrangement is only used when the circuit is oscillating at a fairly high frequency. When it oscillates, the 10k and 22k resistors produce a voltage-divider that is detected by the inverted input of the op-amp. This feature does not apply when the change is very slow.
7. The value of 10p for C3 will have no effect on the circuit.
8. The maximum output current for a CA3140 is 40mA for a 15v supply. The supply will possibly be about 15v due to the point mentioned above and the output will be about 10v due to the arrangement of the 10M resistors and the fact that the output is connected directly to the inverting input. It is unknown what current will be delivered to the LED but the 100R on the LED will make the output very low impedance and the maximum output voltage is unknown.
9. The op-amp will have UNITY GAIN in this arrangement and that is one of the big mistakes of the circuit.
10. The value of R11 is too low. When the pot is turned fully clockwise, up to 30mA may flow through the zener and base-emitter of the transistor. It's just a bad design. Many of the values are far from "design values." Design Values are those you would find in a properly designed circuit.
That's 10 mistakes in a single circuit.

I put the circuit on an electronics forum and got a number readers detecting some of the faults. But none saw the circuit as a whole by identifying all the faults.

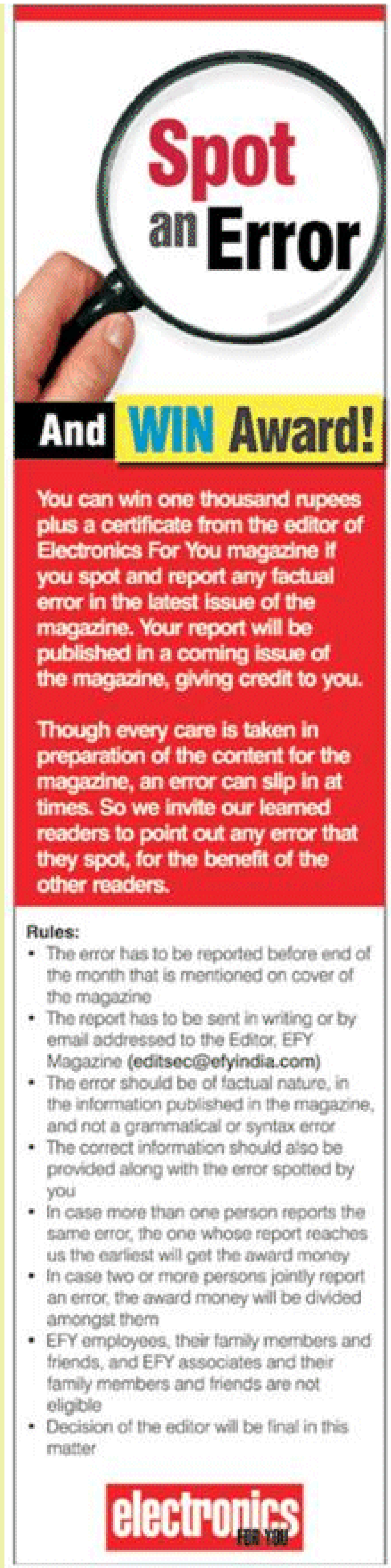
One reader: "amspire" produced a list of answers that were entirely incorrect. I will go though his list:

You have not identified a single fault. Using a 1N4007 instead of a 1N4001 is very common - the 1N4007is often the same price and sometimes cheaper. 1N4001's can be hard to find at times and really only exists for historical reasons that are now irrelevant.
Component values should be shown for a reason. A beginner to electronics may wonder why a 1,000v diode is needed. That's why the circuit should show 1N4002.
You do need a compensation cap on that opamp otherwise it is not stable at unity gain - it is 100% guaranteed to

oscillate without the 10p cap.
A 10p capacitor will have NO EFFECT on reducing the instability. There is no mention of the need for a compensation capacitor in the data sheet.
The 10Meg resistor does not swamp out the diode. At low temperatures, it is the diode that swamps out the 10M resistor.
This is entirely UNTRUE. The 10M resistor in series with the diode will reduce the voltage-change (from the diode) entering the op-amp by a ratio equal to the 10M to the input-resistance of the op-amp. The input impedance of the op-amp is less than 5M and thus less than 35% of the voltage-change will be detected.
C2 and R8 increase the sensitivity to a fast rise in temperature.
The voltage-increase from the diode is very slow in terms of op-amp speed and the capacitor will have no effect.
The maximum that can flow into the transistor base is probably 15mA with the pot at full (and it will not be at full after adjusting) and 15mA will not damage the transistor or zener so that is absolutely OK.
The circuit is so badly designed that you cannot find a starting-point to discuss this section.
However the zener diode is not needed as the voltage-drop across it is NOT 3v1. It will start to leak at a much lower voltage and the transistor will turn on. The zener serves NO purpose.
There are no "design values" for a transistor that you should adhere to - you can do absolutely anything you like with a transistor as long as you do not exceed limits and blow it up. Even Maximum ratings can be exceeded if you know what you are doing - eg using a transistor in avalanche mode for a fast pulse generator. I can go through the whole list, but you have not identified a single fault.

It is lucky we have websites like Talking Electronics to show you how to design a circuit. Of course there are "design values" like 470R feeding a LED and 4k7 to 10k feeding the base of a transistor.

This circuit was sent to **Electronics For You** via their request in the February issue:



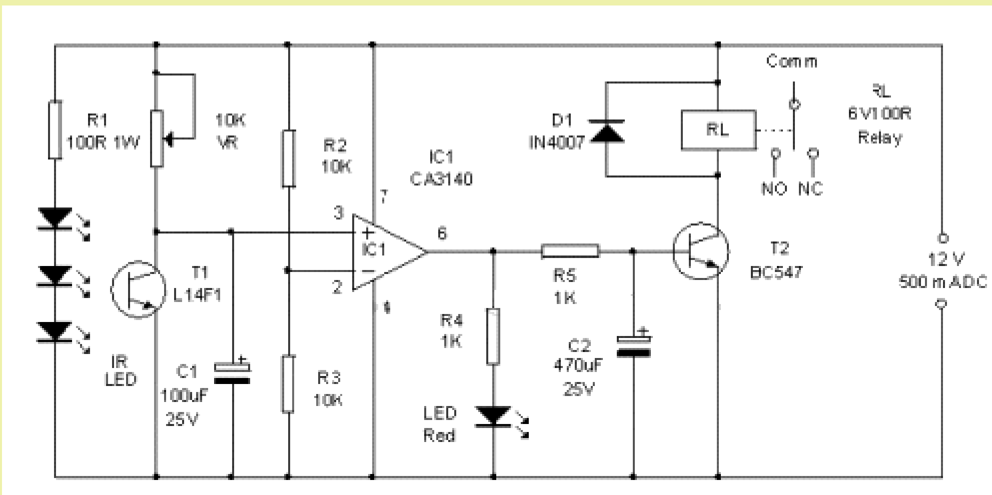
I pointed out 10 mistakes in the above circuit and got a reply from D.Mohankumar:

Mr Mitchell is a Critic of all circuits published in EFY and he is tarnishing the Indian publications and authors. So I am not interested to reply to his queries.

I then said I would analyse circuits before publication in **Electronics For You** because so many of the circuits had faults and this was giving faulty information to newcomers to electronics.
The reply from the "Technical Editor" was: **mind your own bussiness,** (he can't spell business) **we have enough people to look into the mistakes and take corrective action.**

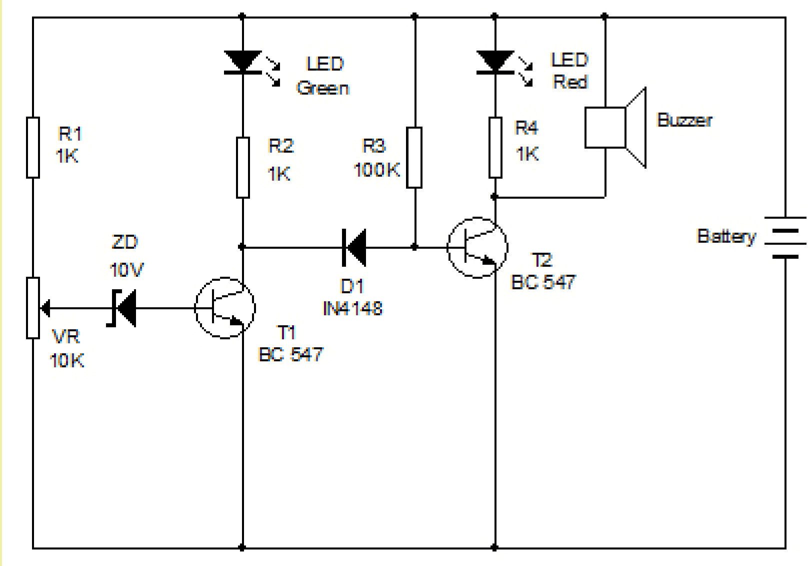
Where are these **technical personnel**???? Why didn't he send my corrections to one of these "technical people"?
Obviously the magazine does not have any technical personnel as it has been publishing circuits with hideous mistakes for over 10 years. Nearly every one of their circuits has technical faults and they don't even want anyone to correct them.
I call this sabotage. They are sabotaging electronics enthusiasts by feeding them with faulty designs and making their chances of successful employment almost zero.
It's people like this and magazines like **Electronics For You** that should not be in the publishing business. They are just ruining the name of electronics.

Here's another circuit with a couple of mistakes. You can see who designed the circuit as it looks just like some of the previous circuits we have looked at:



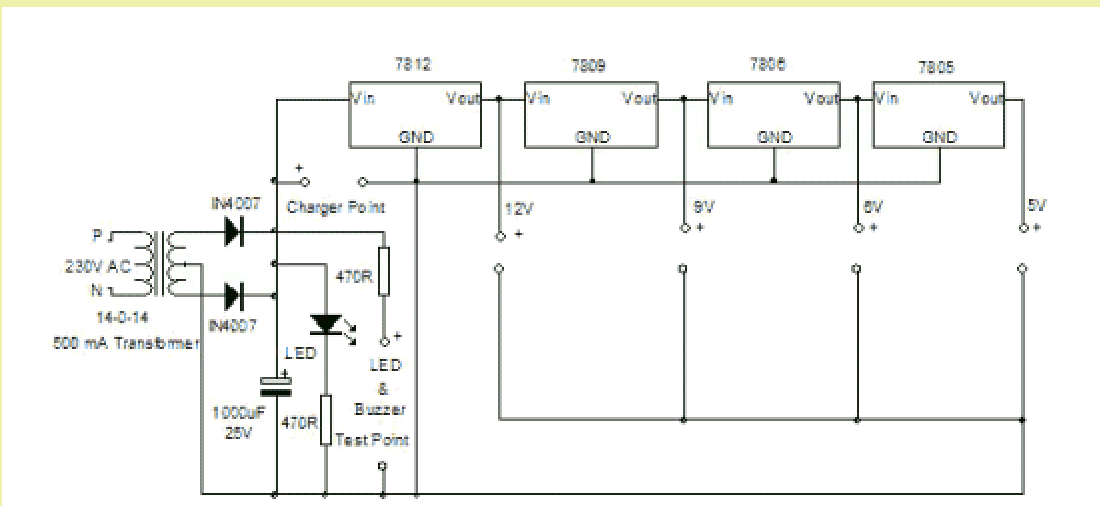
If the 10k pot is turned fully clockwise, photo-transistor T1 will blow up.
When the voltage on the base of T2 is 0.55v, the transistor is not turned on. When it is 0.7v, the transistor is turned on. The 470u C2 is only used for this small voltage range.
By placing a resistor between C2 and T2, (on the base) the voltage-range will be increased and its effectiveness will be increased.

Here's another D.Mohankumar circuit. None of his circuits work. You must **not** build them.



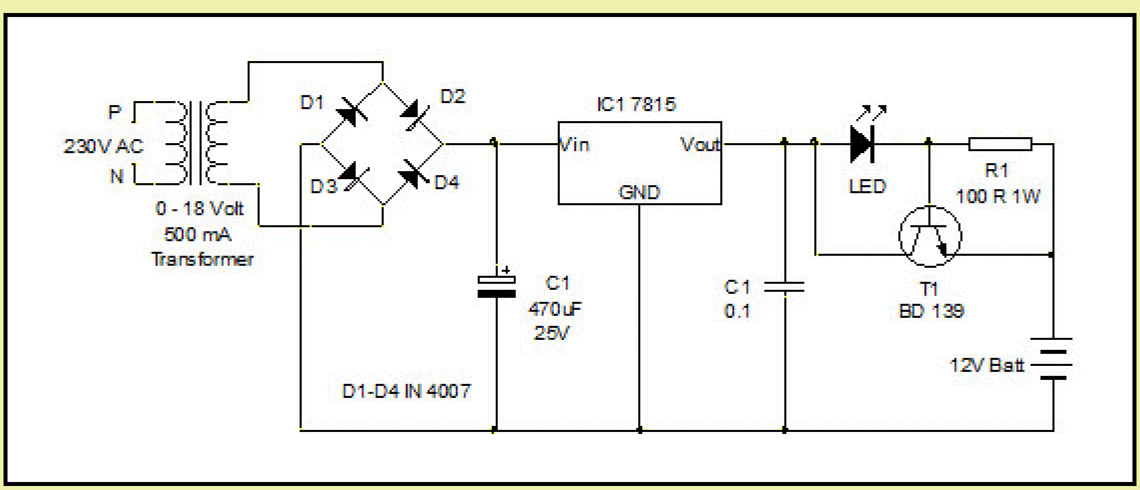
Transistor T2 will never turn off. The voltage across diode D1 is 0.7v. The voltage across the collector-emitter of T1 is 0.2v. This is 0.9v. The voltage on the base of T2 must be less than 0.6v to turn it OFF.

Here's another D.Mohankumar circuit:

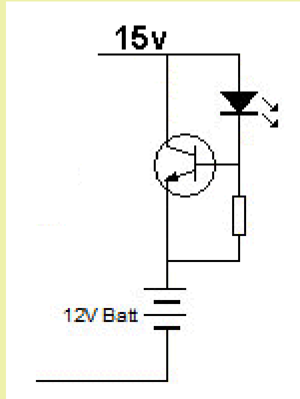


You cannot get a 7805 to work from the output of a 7806. A 7805 requires 8v input.

Here's another D.Mohankumar circuit. It is a battery charger:

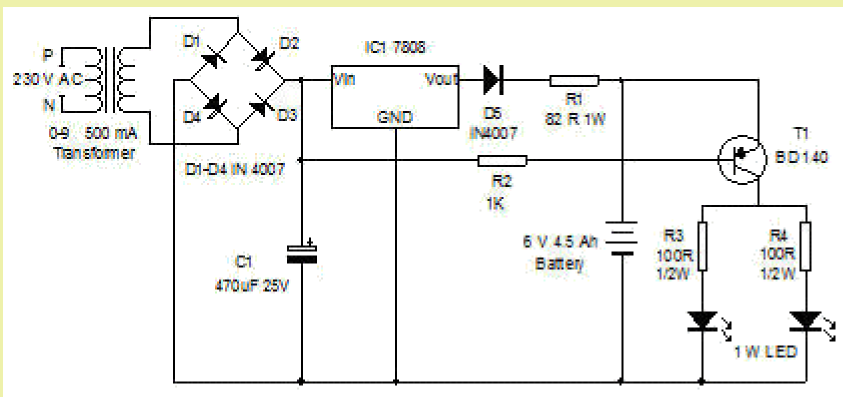


Connecting a slightly flat battery to the circuit will blow up the LED. When the circuit is redrawn, you can see why:



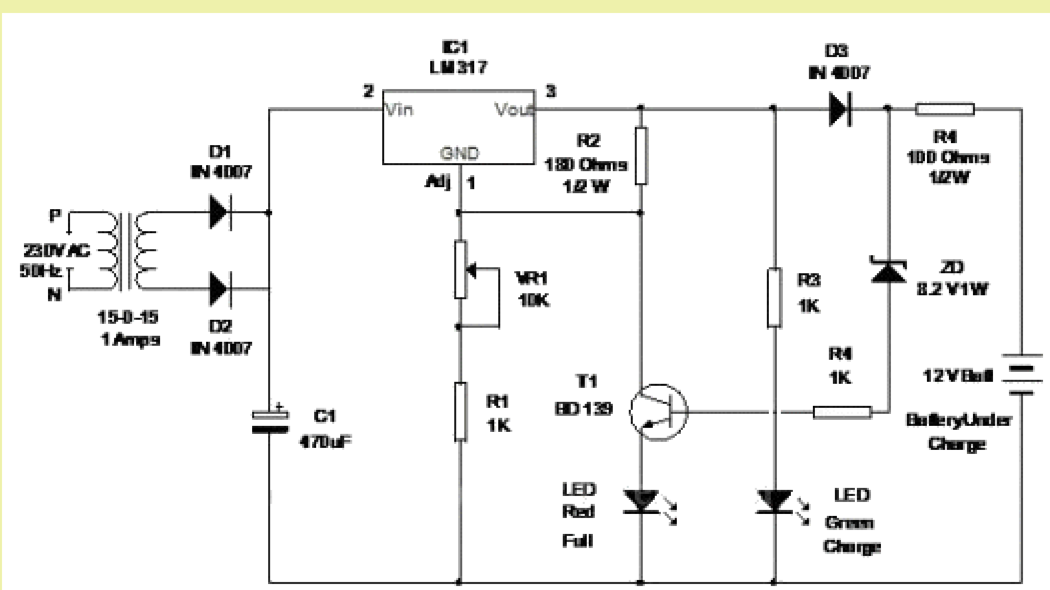
There is a direct connection between the 15v supply and the 12v battery, via a diode-drop of 0.7v which is the base-emitter junction of the transistor. There is no current-limiting resistor and the LED will blow up.

Here's another D.Mohankumar circuit. It is an emergency lamp:



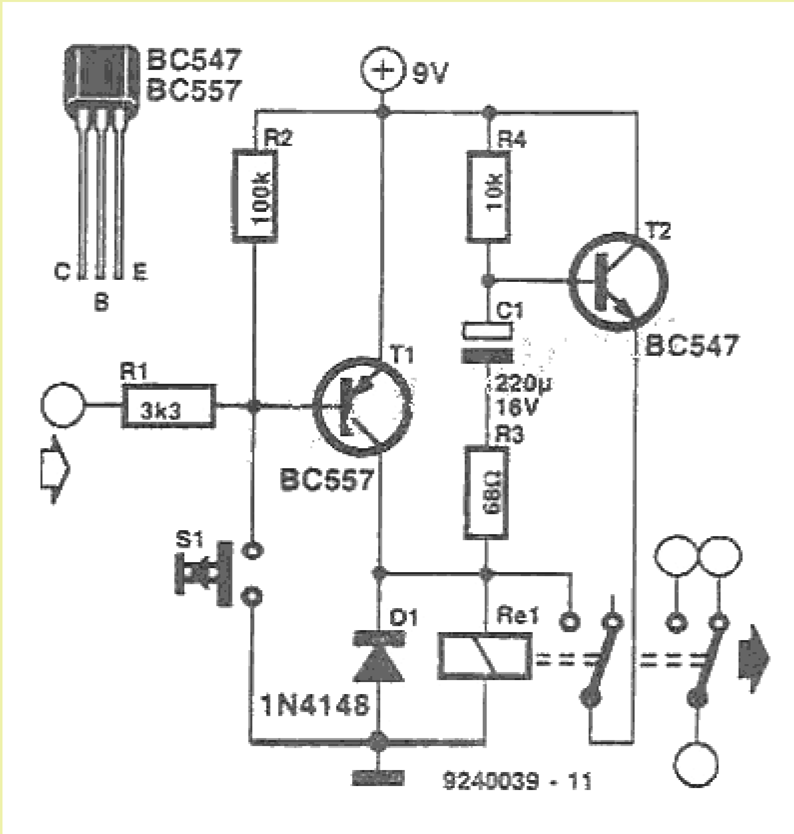
A 1watt LED takes 300mA.   The voltage drop across a 100R when 300mA flows is 33v!! The 100R can only deliver 25mA.
What is pulling the base LOW when the power fails? Another untested circuit.

Here's another D.Mohankumar circuit. It is a battery charger:



The circuit is supposed to turn the current off when the battery reaches 13.5v. But the "turn-off" circuit consists of an 8v2 zener, the base-emitter junction of T1 and the voltage drop across a red LED. This is 8v2 + 0.7v + 1.7v = 10.6v The zener needs to be 11v.

This circuit toggles the relay each time the switch is pressed.



Pressing S1 will blow up transistor T1. A 4k7 resistor should be connected in series with S1.
The operation of this circuit is very clever and quite complex. See the full explanation of how the circuit works in "101-200 Transistor Circuits". Toggle A Relay

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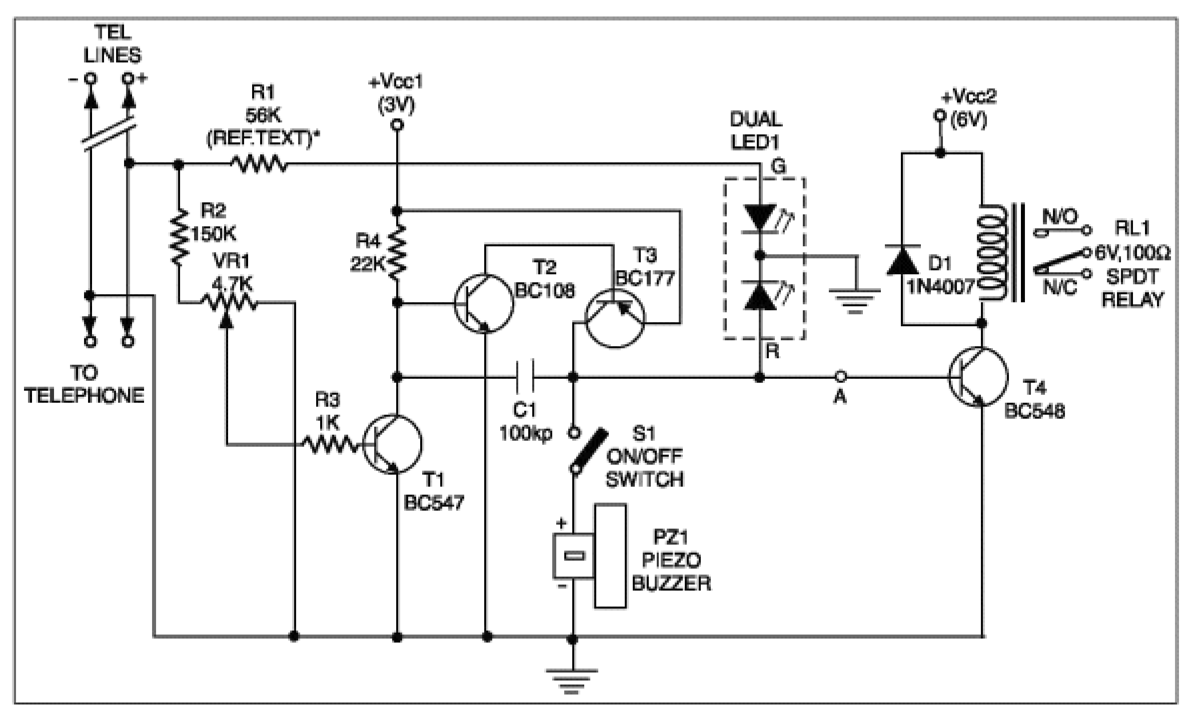
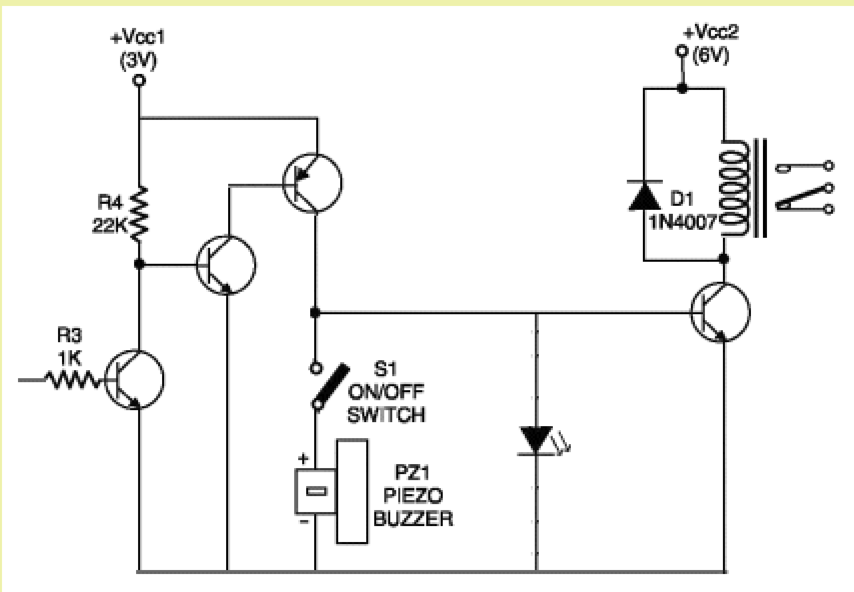
Here's another circuit from **Electronics For You.** It has not been checked by a qualified design-engineer. The circuit possibly works but when you find out how it operates, you will be HORRIFIED.



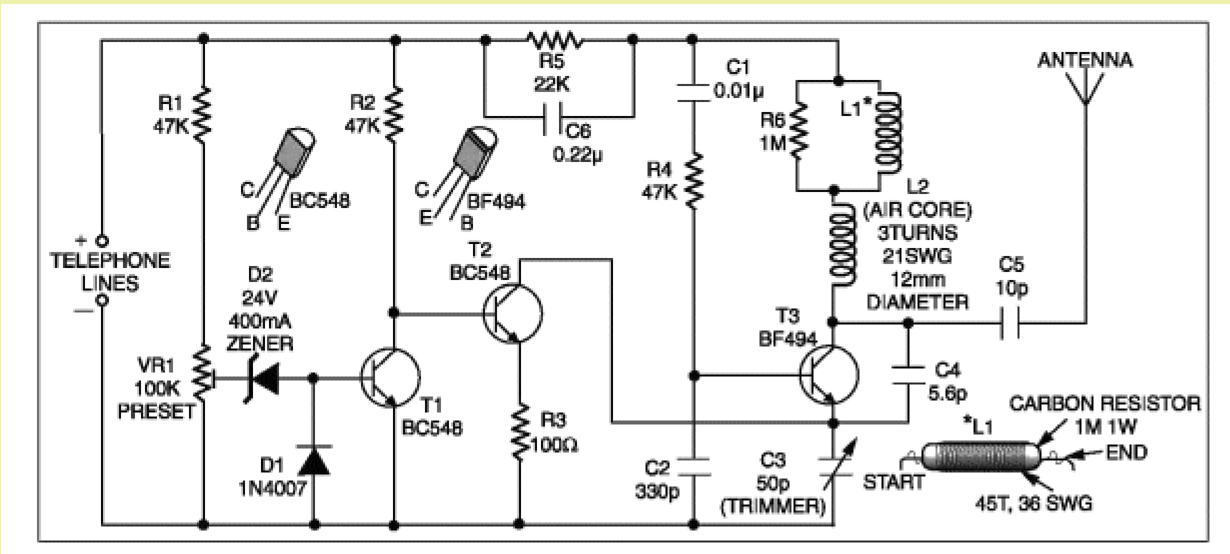
It is absolutely essential to draw a circuit so it is instantly understandable.
The connection of the first three transistors looks unusual, so the circuit was drawn in an understandable way.



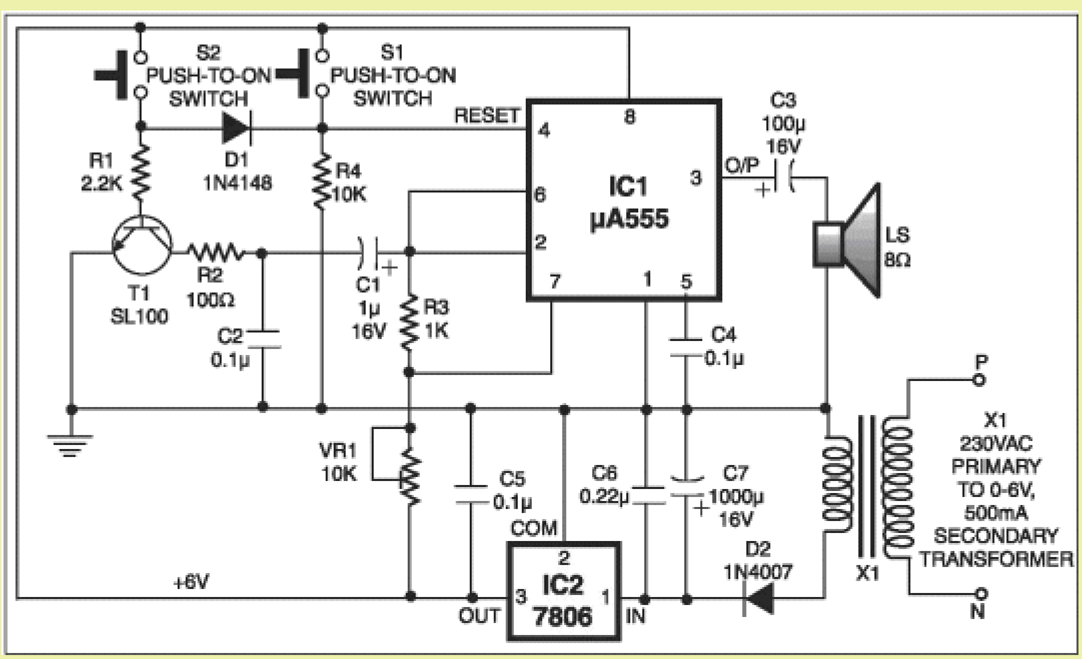
You can see the 3v supply goes through the emitter-base junction of the 3rd transistor and collector-emitter junction of the second transistor, without any current-limiting resistor.
When the first transistor is NOT turned on, the second transistor is turned on via the 22k resistor and this pulls the base of the third transistor towards the 0v rail. The emitter will have about 0.9v on it and the current through the two transistors will be very high.
This is an extremely BAD design.
The voltage on the collector will be about 0.7v. The transistor driving the relay will turn on but the LED on the base will not illuminate and the Piezo Buzzer will not produce a sound.
When the first transistor is turned ON, the second transistor is turned OFF and the third transistor is turned OFF.
What a terrible design.
Electronics For You informed me they do not have a technical that understands electronics technology and simply publish the circuit because "it works."
Now you can see how damaging this simplistic approach is. 40,000 young electronics enthusiasts are a getting the wrong idea on circuit design because the magazine does not know how to test a circuit.

Here's another disaster from **Electronics For You** magazine**.**

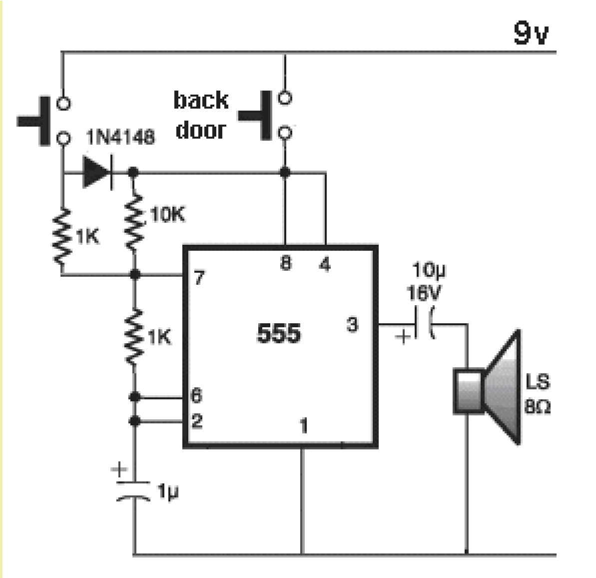
It's an FM Bug that connects across the phone line. All Talking Electronics Phone Bugs connect to one of the lines by cutting the wire and inserting the circuit. A bridge on the circuit automatically adjusts to either polarity and you don't have to worry about the high voltages of the phone line.
The following circuit is a disaster. The output transistor is a 20v device and it will zener (actually break-down) when connected to the line and that's why the "laboratory" at **Electronics For You** had to add the 22k. Instead of working out why the circuit engaged the phone when connected to the line, they added the resistor.
But the major faults are:
The 47k resistor is not connected to the top rail and the oscillator transistor i s not turned ON.
The coil in the collector does not have a capacitor across it to make a TANK CIRCUIT and the circuit will not work.
C1 should be connected to the base of the transistor.
C2 is not needed.
That's 5 faults in a single circuit.
Another terrible design.



Here's an over-designed circuit, with mistakes. If the 10k is turned clockwise, pin 7 will be damaged.



Here's the circuit with corrections and simplified:



A 6v battery must be charged from a supply that is no more than 6.8v.
This circuit delivers 7.5v and the battery will gradually DRY OUT. The circuit needs to be redesigned with a current-limiting resistor or a power diode on the emitter of T1 to reduce the output of the regulator to 6.8v.

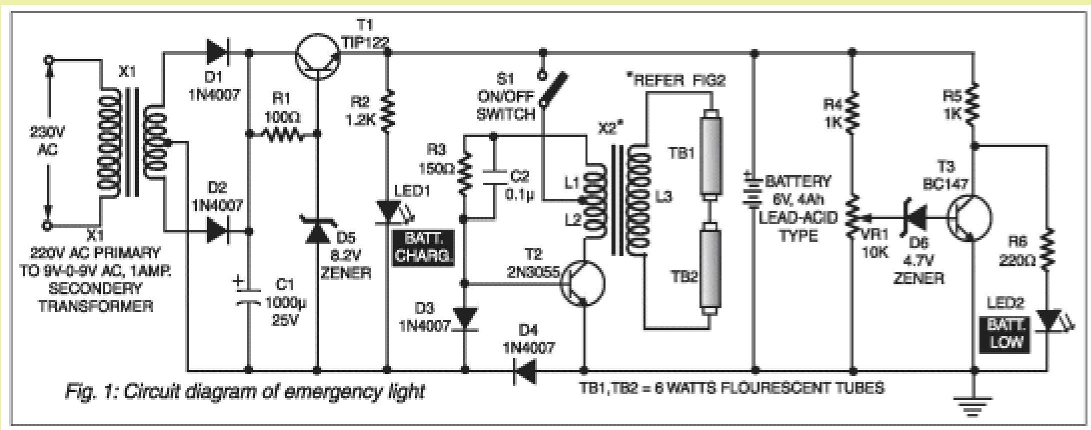
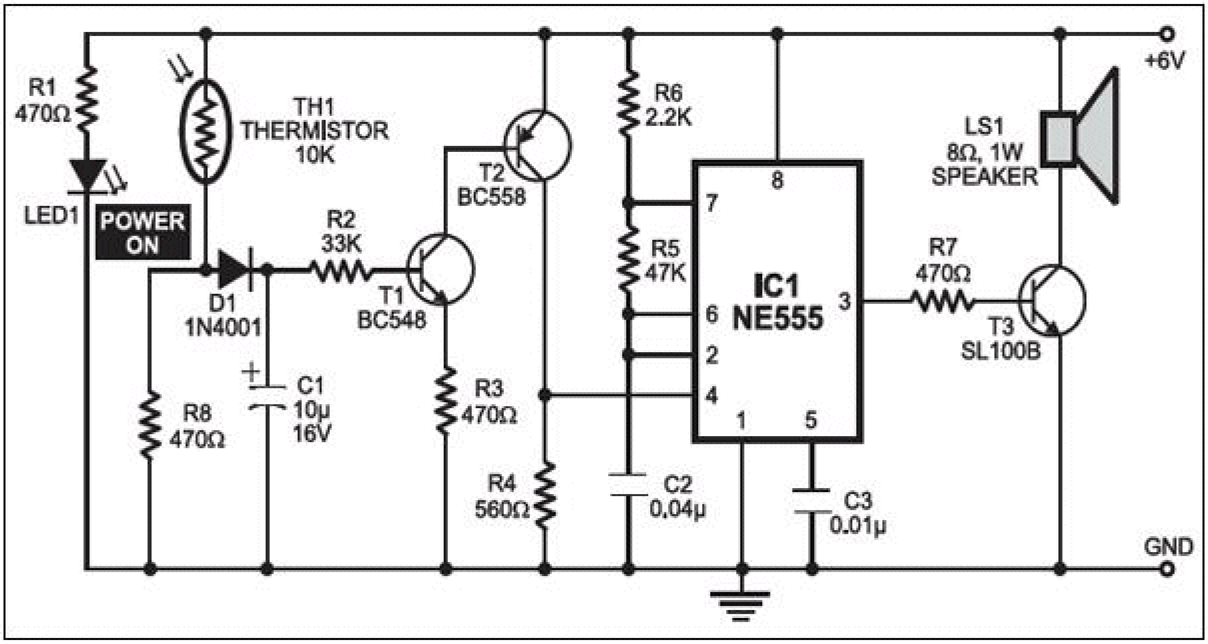


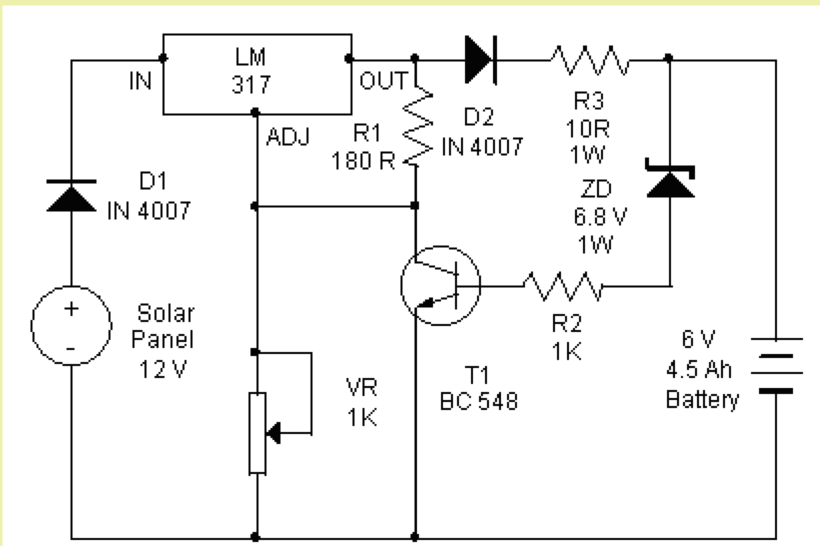
Fig. 1: Circuit diagram of emergency light

FIRE ALARM

This circuit detects heat via the thermistor. As it gets to 100°C, its resistance decreases to about 1k.
The diode, R2 and electrolytic are not needed. By adjusting the value of R8, the voltage on the base of T1 can be sent so the circuit turns on at an elevated temperature.
As the voltage on the base of T1 increases, the transistor turns on and the emitter rises. This means the voltage on the base must rise higher to turn the transistor on more. This is not a problem in this circuit but resistor R3 (470R) should be in the collector of T1 so that a rise in base voltage will be passed to the output.
The worst feature of the circuit is the current-drain. The circuit takes 10mA and most fire alarms take only a few microamps so the battery lasts for a year or more.
By connecting pin4 and 8 of the 555 to the collector of T2, the chip will not be powered during the waiting period and the circuit will take much less current.



Here's another D.Mohankumar faulty circuit. It is a solar battery charger:



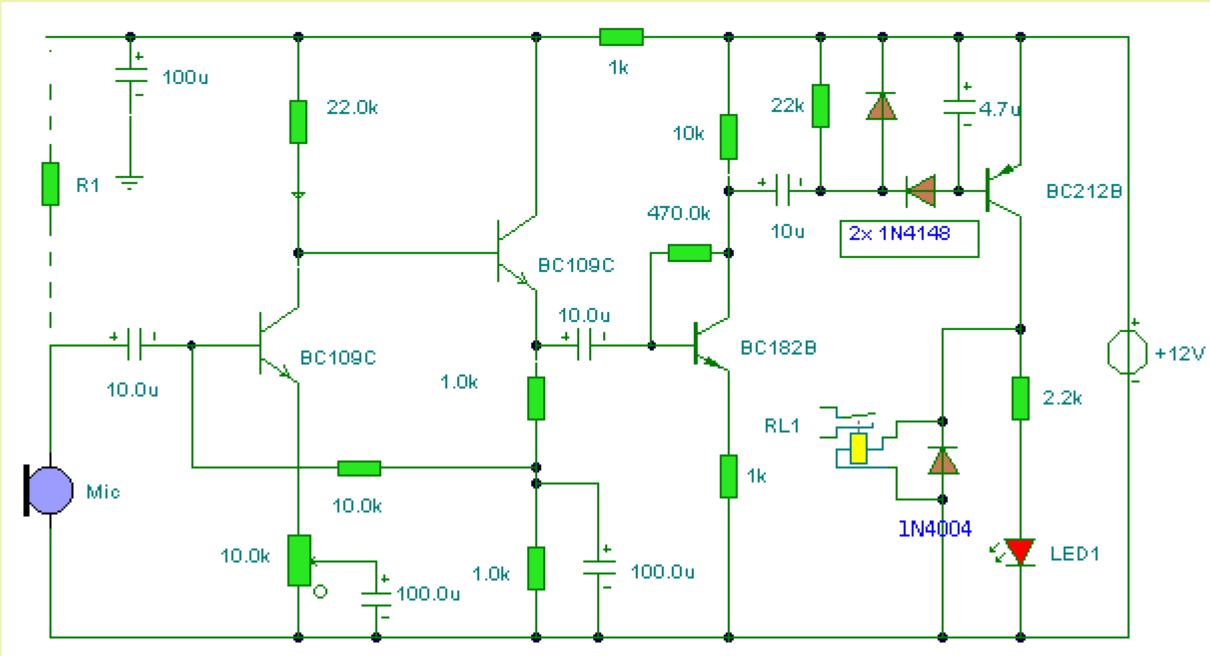
Solar Charger with Current regulation and Cut off

Here is a reply from a reader:

I assembled the Solar Charger circuit as per your design. The solar panel when not connected in circuit shows 22.5VDC. But when I connect it in the circuit the output shows 0.79VDC.

D.Mohankumar could not answer the question.
A zener diode is not designed to be used as shown above. A zener diode is very "leaky" and any voltage on the cathode is transferred to the other lead and it will appear on the base of the transistor.
That's what is happening in this circuit and the output only has to rise to 0.9v and the transistor is already turned on and taking the **adj** terminal of the regulator to 0v rail.
This circuit does not work. Another untested circuit by D.Mohankumar.
Why use a 12v panel to charge a 6v battery? This makes the circuit less than 50% efficient.
Why have any electronics AT ALL? A 4.5aHr battery can be constantly supplied with 300mA and it will not be overcharged. Use a 6v 300mA - 500mA solar panel with a single diode to prevent current flowing back into the panel when it is not illuminated. That's all the circuitry you need as the panel will be supplying energy for no more than 8 hours per day and the battery will not get overcharged.
You have to think "outside the square" and ask: "Is a complex circuit necessary?"

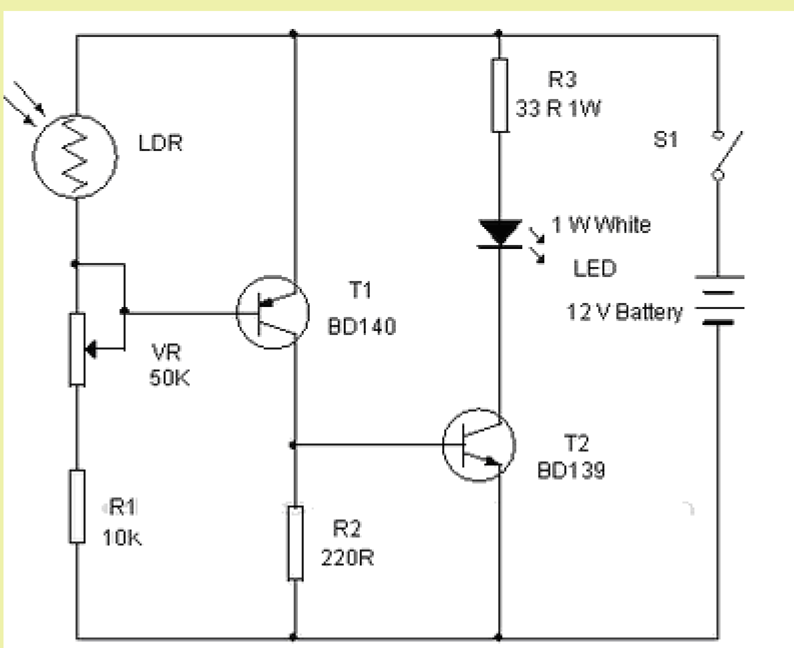
SOUND SWITCH



There are a couple of technical faults with the circuit:
The 10k base resistor to the first transistor is far too low. It should be at least 100k.
A low-value resistor will reduce the incoming waveform from the microphone by about 50%.
The electret microphone will produce a waveform of about 2mV to 20mV. The first transistor will have a gain of about 100. The result will be a maximum of 1,000mV
The second transistor is an emitter-follower and will not increase the amplitude of the waveform.
The third transistor has a fixed gain of 10 due to the ratio of the 10k collector resistor to the 1k emitter resistor.
The circuit will produce sufficient waveform (about 1,000mV x 10) to turn on the fourth transistor but the 10u feeding the diodes is around the wrong way and the 4u7 will have a greater effect if it is away from the base by adding a 4k7 resistor.

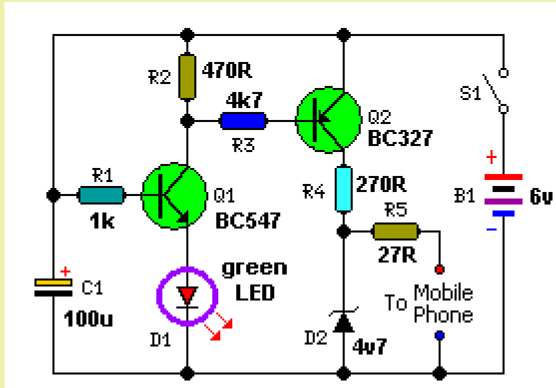
EMERGENCY LIGHT

If the pot is turned fully clockwise, the BD140 will take more current and this will flow through the base-emitter junction of the BD139. This current will be more than required by the BD139 and it will be damaged.
The current taken by the 1watt LED will be 12v - 4v = 8v / 33 = 240mA. The wattage of the 33R should be 8 x .24 = 2 watts.

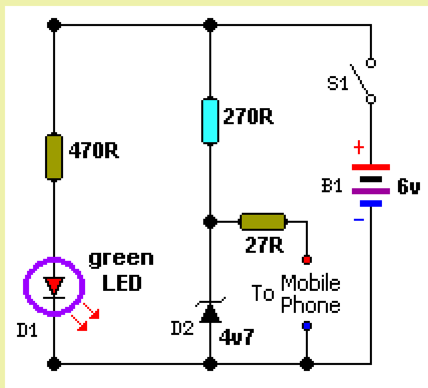


MOBILE PHONE CHARGER

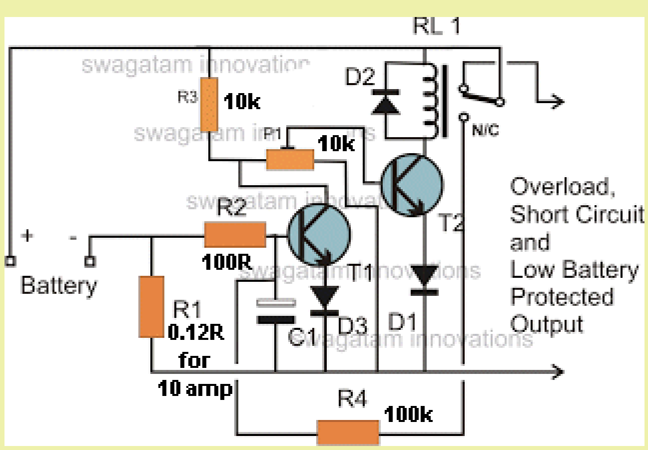
Transistors are not added to a circuit to make it more complex. These transistors are NOT NEEDED.



Remove the transistors and the circuit will work exactly the same as before:

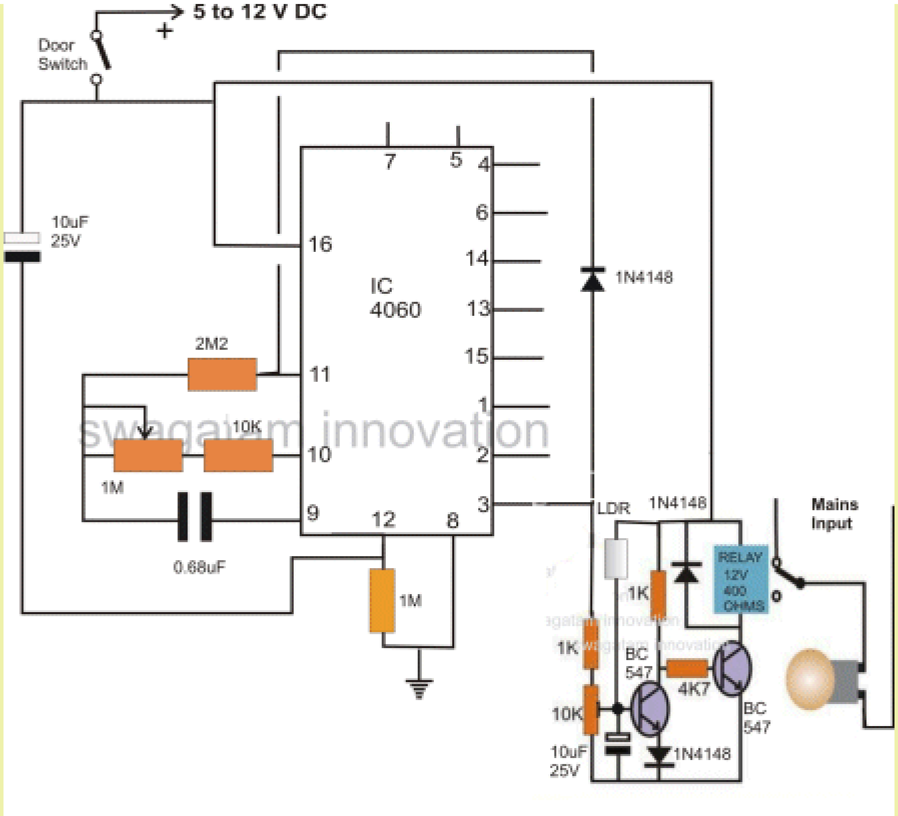


Here we have a circuit from [Swagatam Majumdar](). It has a number of faults:



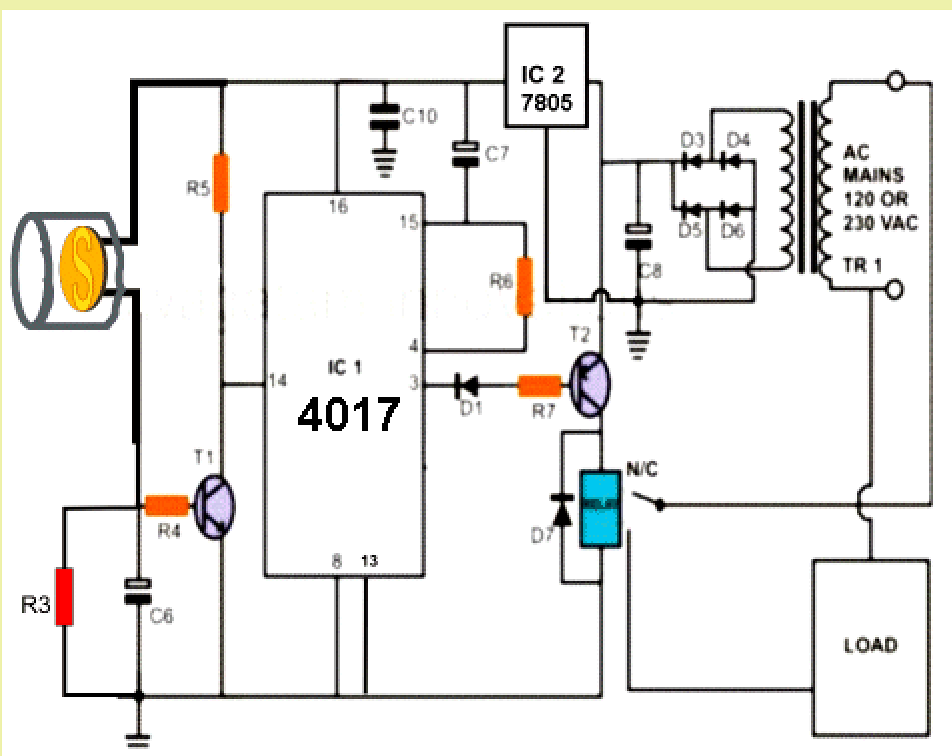
I have only identified the resistors as this is where the faults are located.
1. The value for R1 is 0.12 ohms for 10 amp load due to the fact that diode D3 has been placed on the emitter of transistor T1. This diode is not needed. Removing the diode allows R1 to be 0.06 ohms and 6 watts instead of 12 watts. A huge difference.
2. D1 is not needed. It serves NO purpose.
3. The value of R4 is far too high. It will NEVER keep T1 in conduction. R2 needs to be increased to 10k and the circuit will work.
Obviously the circuit has never been tested. Two unnecessary parts and two incorrect-value resistors.

Here's another untested circuit from [Swagatam Majumdar]():



The voltage on the collector of the first transistor will be 0.7v plus 0.2v = 0.9v when the transistor is conducting and this will not turn off the second transistor. The diode must be removed. It serves NO purpose. He adds a diode to the emitter in all his circuits and this is completely unnecessary and creates faults circuits. He claims to be an "electronics engineer" and yet most of his circuits have not been tested and DO NOT WORK.

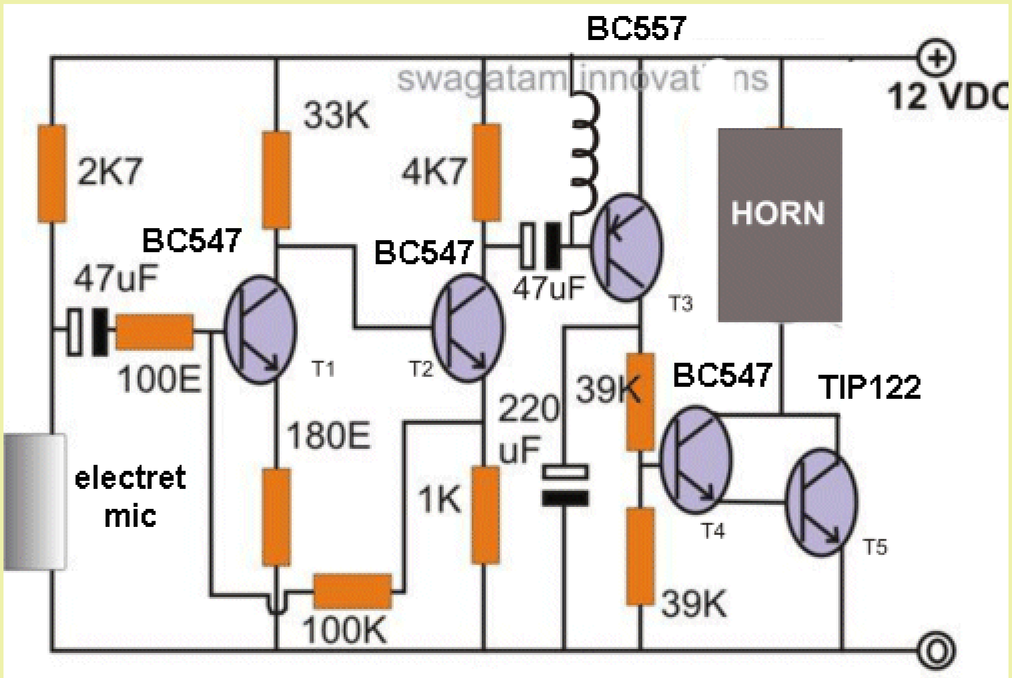
Here's another untested circuit from Swagatam Majumdar.
I have only identified the 7805 and 4017 as this is where the fault lies:



The voltage on the collector of the PNP transistor is about 12v. The voltage on the supply-rail of the 4017 is 5v. The output of the 4017 cannot rise higher than 4.5v. To turn off the PNP transistor (T2) the base voltage must

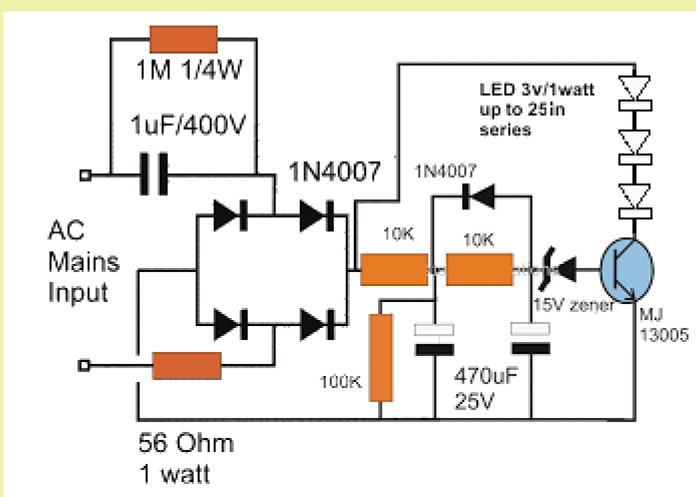
rise to about 11.5v
In this circuit the transistor will NEVER TURN OFF.
That's why you use an NPN transistor on the output in this type of circuit. You can then use different-voltage supplies.

Another circuit from [Swagatam Majumdar] with a few minor mistakes. The circuit detects when a car is hit or bumped and sounds the horn for a short period of time.



The 2k7 load resistor for the microphone is too low. It should be 47k or higher. You only want to detect a strong hit or bump.
The 100 ohm resistor on the base is not needed. It serves no purpose.
The "coil" on the base of T3 is an unknown component and should be removed.
The two 39k resistors on the input to the "Darlington" arrangement should be 100k so the 220u can be reduced to 100u.

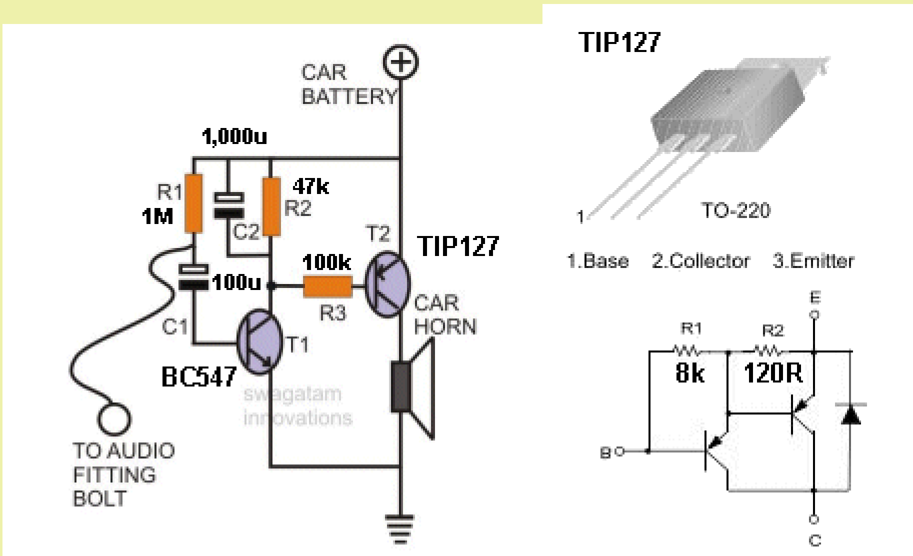
Here we have a capacitor-fed power supply with a slow turn-on feature:



When the voltage is applied, the output of the bridge is effectively 330v with a current of 70mA. The 330v will be directly across the first 10k resistor and it will start to charge the 470u. The voltage will then pass through the second 10k and start to charge the second 470u.
Suppose we remove the LEDs and see what happens.
The result is 330v on the output of the bridge, 172v on the first electro and 15v on the second electro. The

transistor now turns on and the 25 white LEDs produce a voltage-drop of 75v. The voltage on the first electro drops to 45v, but it will blow up. The 100k must be reduced to 10k.
Now we come to the next problem.
The 1u capacitor will deliver 70mA and in this type of circuit the 70mA current is being delivered to the load and it must be able to accept (dissipate) the wattage. The wattage will depend on the voltage across the load and in this case we have two paths. The 10k plus 10k plus 15v zener path takes 3mA because the supply is 75v.
The remaining 63mA will flow though the white LEDs and BLOW THEM UP it they are ordinary LEDs. They have to be high-wattage LEDs and although 1watt LEDs require 300mA for bright illumination, 63mA will produce a very good output.
As you can see, the physics behind this simple circuit is much more complex than you think.

Here's another untested circuit from [Swagatam Majumdar](#).



The circuit will not work because the author failed to realise the Darlington TIP127 transistor has inbuilt resistors. To pull the base down by a voltage equal to 0.7v plus 0.7v, resistor R3 must be less than 60k. At 60k, the transistor is just at the point of turning on.
Now we come to the next problem.
A car horn requires about 4 amp to produce an output. But the coil inside the horn is only being activated for about half the time and this means the starting current to activate the electromagnet is 8 amps. This point has never been mentioned before and is one of the hidden problems with driving a horn.
To fully drive the transistor (fully saturate it), the base current must be increased and the base resistor will have to be reduced to 33k.

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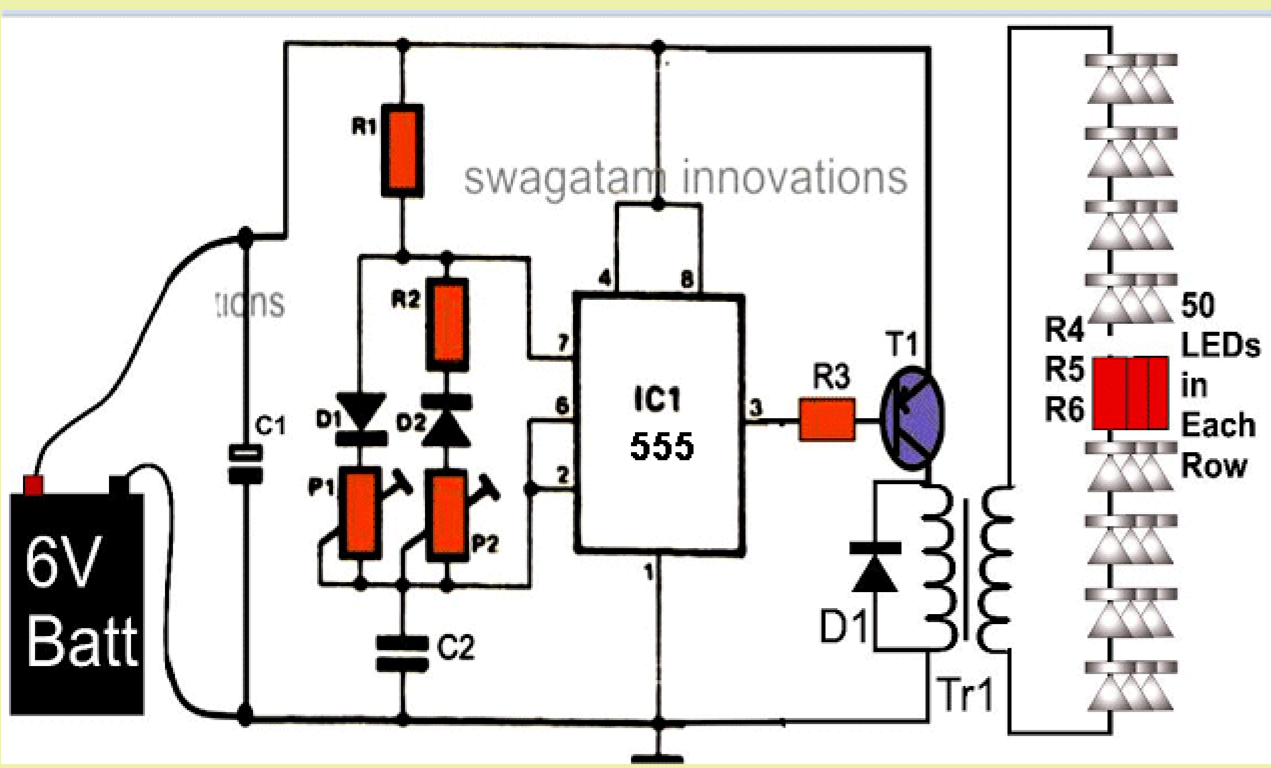
SPOT
THE MISTAKES!
Page 16

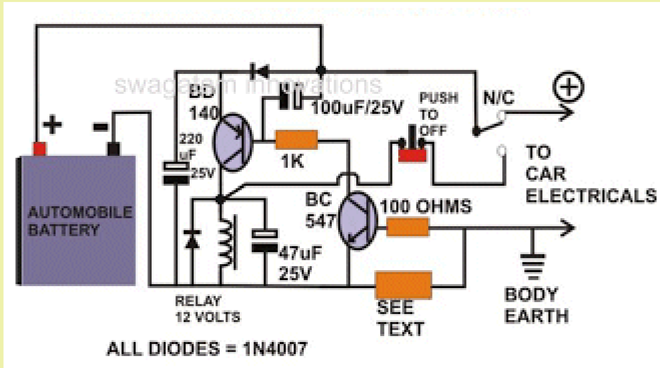
It is pleasing that these pages are read by a number of visitors who are deeply interested in learning electronics. You will find the discussions we have presented have never been covered in any text books and yet this type of analysis is the most important way to learn.
Many of the circuits come from "Electronics Professionals" or "Electronics Technicians" and yet they contain faults. Most of the faults are due to inadequate testing but many are due to the fact that the circuit has not been put together and tested AT ALL.
It is an absolute fallacy to think you can design a circuit and "It will work."
There are many hidden problems such as in-built resistors in transistors, transistors getting too hot, zener diodes that leak, and the list goes on.
40 years ago I presented a circuit and forgot a component. The circuit did not work. I vowed I would NEVER present a circuit without building it and thoroughly testing it. That's the only way to prevent making a FOOL of yourself.
Electronics is wonderful. It PULLS YOU UP. It corrects your mistakes and doesn't allow faulty circuits to work.
All you have to do is TEST IT.

Another untested circuit:



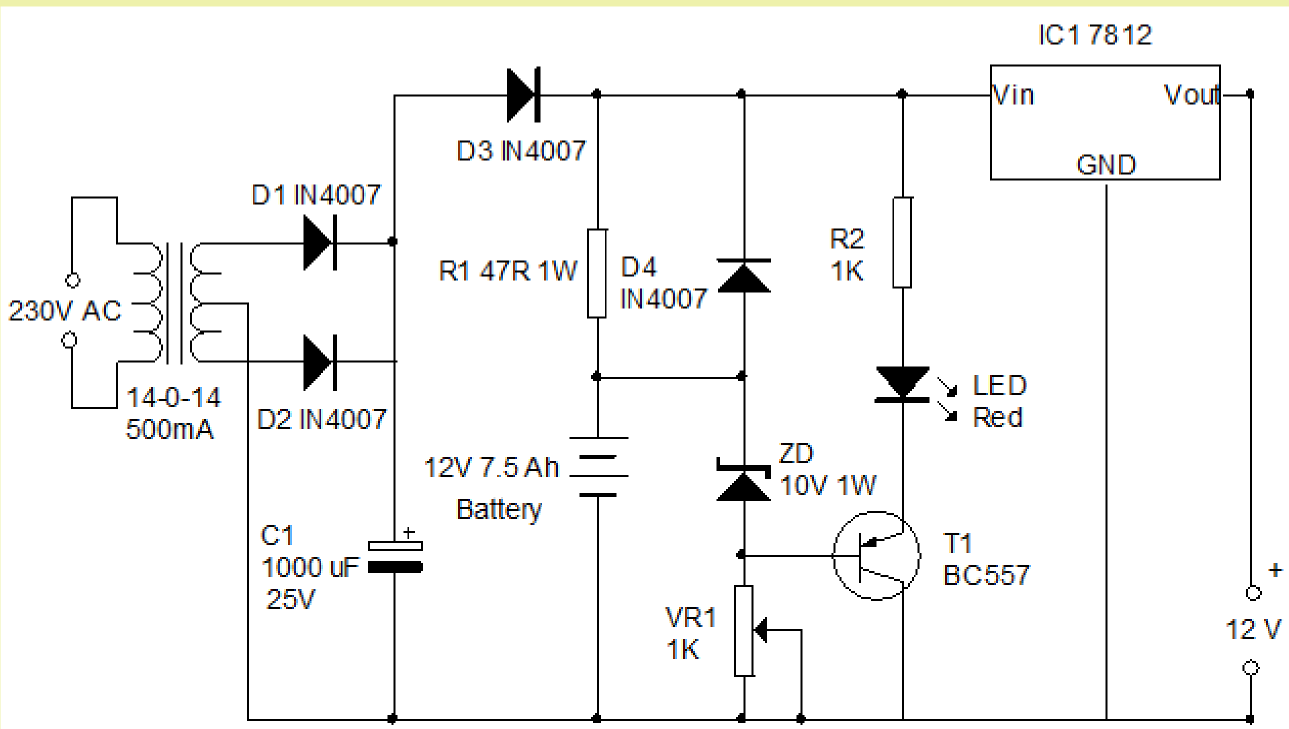
Pin 3 of the 555 does not rise higher than 3.5v for a 6v supply. This is one of the major problems with a 555. This means the PNP transistor will not turn OFF when pin 3 is HIGH and the circuit WILL NOT WORK.

Car Fuse. Another circuit that will not work



The BC547 will never turn ON. It is around the wrong way. The base must be 0.7v higher than the emitter for it to turn on.

Another untested circuit:

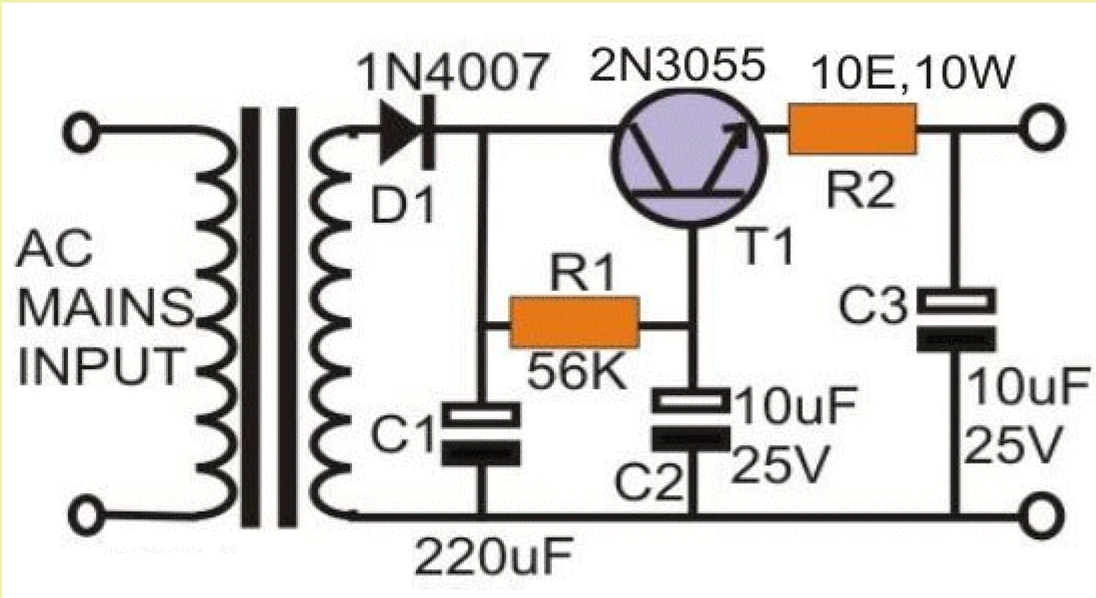


What is the purpose of D3? It serves NO purpose.
The 1k pot does NOTHING. If you turn the pot completely clockwise, the 10v zener will be across the battery and it will burn out. And the pot will be destroyed.
The pot will never turn the LED off.
The 14v transformer will produce 14 x 1.4 = 19.6v less 1.4v = 18.2v to charge a 15.5v battery across a 47R resistor. The current will be 60mA. Fortunately the transformer will produce about 4 volts more because of the extra winding on the secondary and the current will be 150mA. Just a trickle charge for a 7.5Ahr battery.
But the most important fault is the fact that the 7812 will not work when the power fails. It requires at least 3v above the output voltage for the electronics inside the chip to provide the output voltage and current. This circuit has never been tested.

D.Mohankumar has absolutely no idea about electronics. Here is his rubbish explanation of how the circuit works:
Zener diode ZD and the PNP transistor T1 form the low battery indicator. **No they don't**
When the battery voltage is above 11 volts, Zener conducts and keeps the base of T1 high so that it remains off.

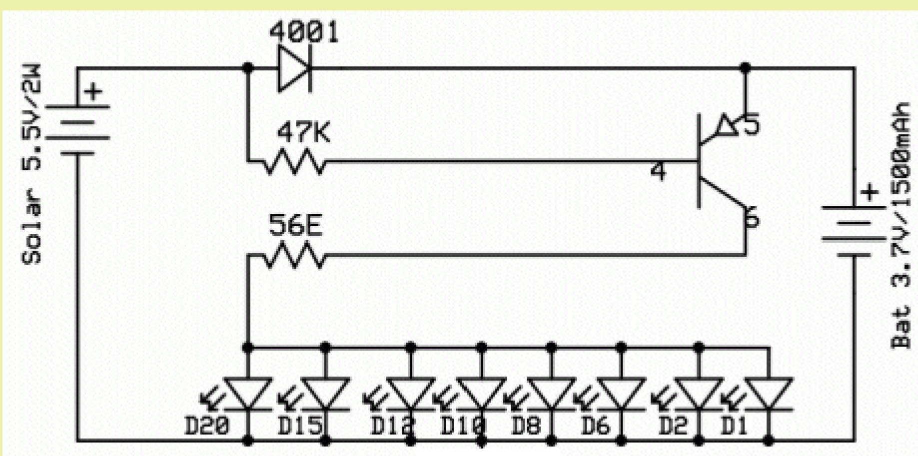
This is NOT true. The transistor is connected as an emitter-follower and it conducts as soon as the emitter is 0.7v below rail voltage. In other words it conducts ALL THE TIME in this circuit.
When the battery voltage drops below 11 volts, the Zener turns off and T1 forward biases. LED then lights to indicate the need for battery charging. **This is NOT true. D.Mohankumar has no idea how a transistor or zener diode works.**

POWER SUPPLY. Another faulty circuit:



The main fault with the circuit is the 56k.
When you see a resistor on the base of a transistor, you immediately divide the resistance on the base by the gain of the transistor and this will be the approximate resistance of the transistor. It's only a quick way to see if there is a fault in the circuit.
The gain of a 2N3055 is a maximum of 70. Using this value we see the transistor becomes an 800 ohm resistor!! It will deliver no more than 30mA. This circuit has never been tested.

This simple circuit has three faults:



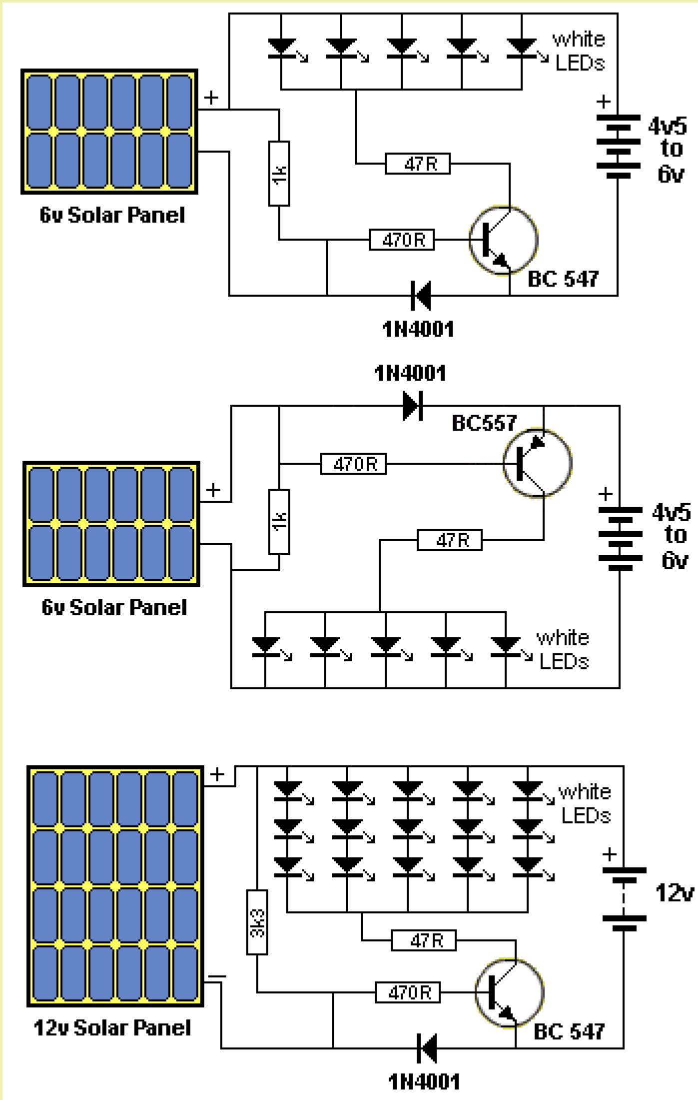
The first fault is the 47k resistor. When the solar panel is not illuminated, the author of this circuit thinks the 47k resistor will be connected to the 0v rail.
This is not so. The impedance (resistance) across the terminals of the panel is an unknown value and measuring a few panels resulted in values from a few kilo ohms to 100,000 ohms.
During this time the current through the 47k will turn on the transistor and illuminate the LEDs.
The current though the 47k will be 3.1/47,000 = 0.065mA. If the gain of the transistor is 200, the collector current will be 13mA. Each LED will receive less than 2mA.
Although the characteristic voltage for a white LED is 3.5v, they start to illuminate at about 2.8v and since the

circuit will only deliver a very small current, the LEDs will produce a small amount of illumination.
The circuit is not technically correct as the voltage across a white LED (3.5v) plus the voltage drop across the transistor (0.2v) leaves no voltage for the current-limiting resistor (56R).

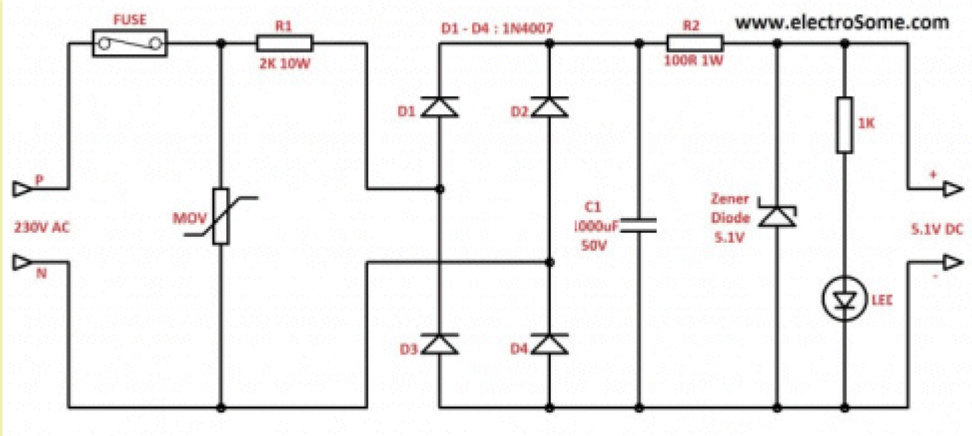
The author of this circuit is Sebastian Kushero. He refuses to admit there are any faults with the design.

He replied:
Colin Mitchell has made it his business to denigrate Indian designers. The circuit provided by us works. If it works that ends the conversation.

Firstly, I was not aware the author was Indian. I just criticized the faulty circuit, not the designer.
Secondly, to say "the circuit works" is not an engineering reply. It was presented on a forum and a number of the readers could not get it to work successfully. Sebastian Kushero made no effort to resolve the issue.
The circuit needs 3 changes for the LEDs to produce good illumination. Here are the modifications:



Before producing even the simplest circuit, you have to know what you are doing.
Here we have a resistive power supply with a 2k @ 10watt resistor on the front-end. But the resistor will dissipate more than 22 watts.
How do you work out the losses?
The current though the circuit will be = 224/2,100 (230v minus 0.7v minus 0.7v minus 5.1v) = 0.107 amps.
Power lost in 2k resistor = 0.107 x 0.107 x 2,000 = 22 watts



Here we have another circuit from electroSome:

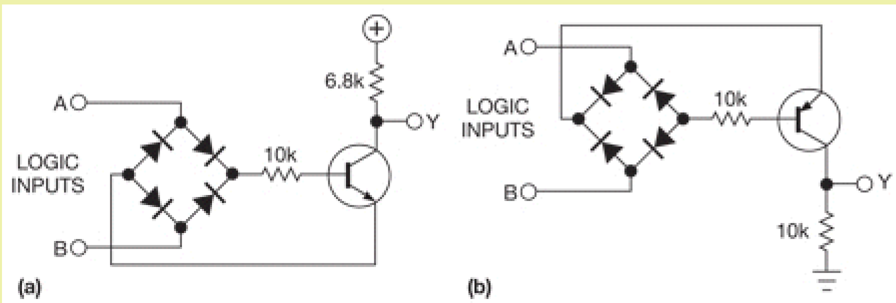


Figure 1 Discrete implementations of XNOR (a) and XOR operations (b) allow you to run logic at higher supply voltages than standard logic families.

The circuits may work, providing the voltage on the collector is 0v when the first circuit is active and about 5v for the second circuit.
The first circuit shows the transistor is capable of being turned on via the bridge but it does not show how the voltage on the collector changes. The circuits are incomplete.

Here is a circuit from March issue of **Electronics For You**. Apart from the fact that the circuit is very complex, the 1k5 base resistor on the output transistor does not turn the globe ON fully and the transistor gets very hot.
The circuit can be simplified to 3 transistors and 3 resistors. The object of an electronics magazine is to provide the simplest circuit for the task. Imagine how annoyed a constructor would be when he finds the same result can be achieved with less components.

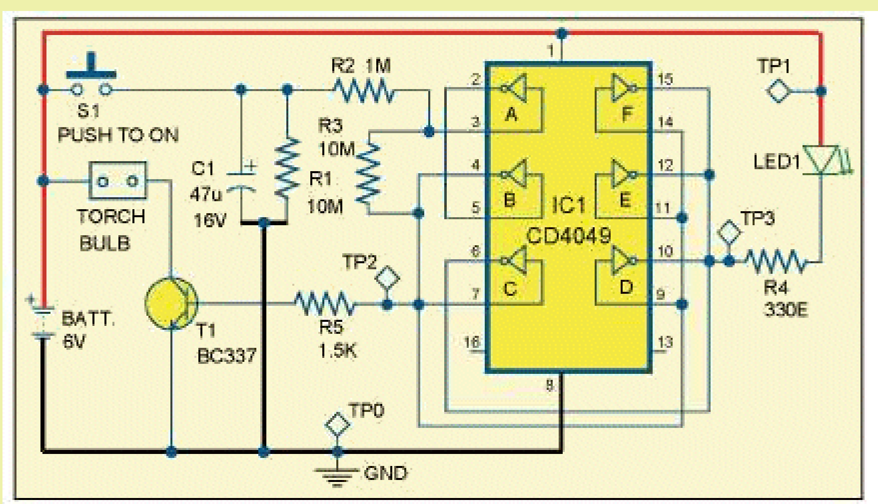
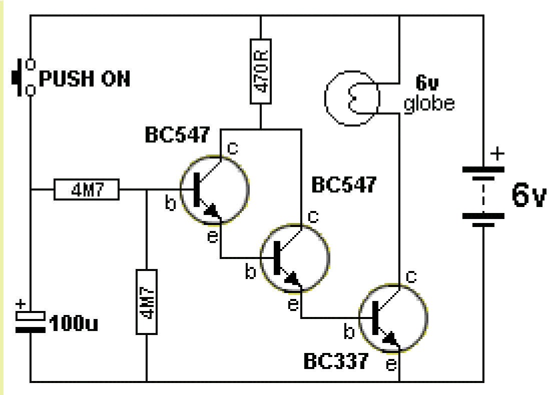
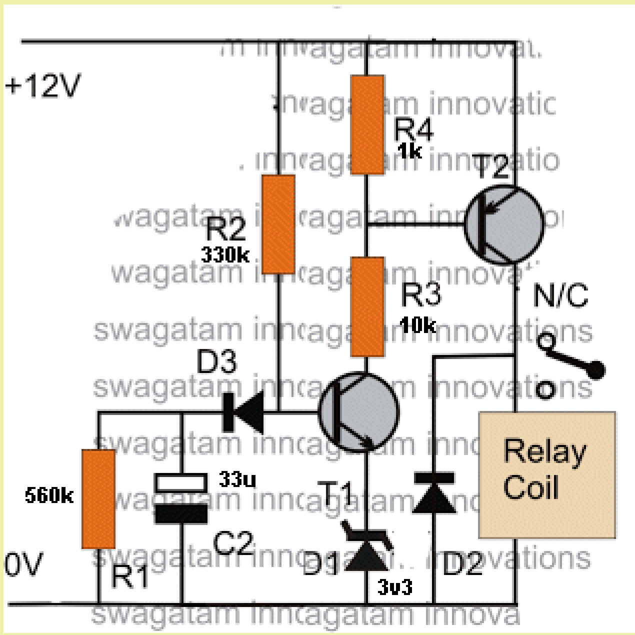


Fig. 1: Circuit for cupboard light



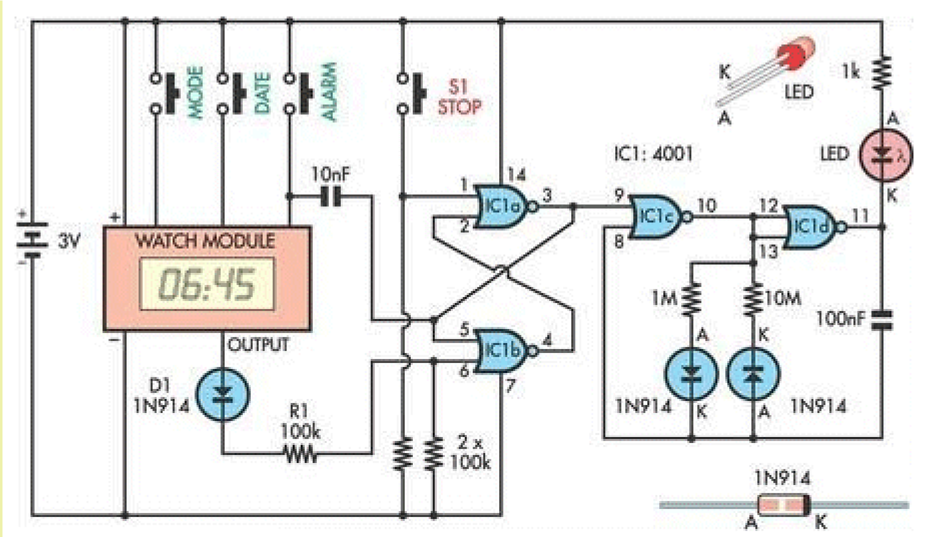
CUPBOARD LIGHT USING TRANSISTORS

Here's an over-complex circuit:



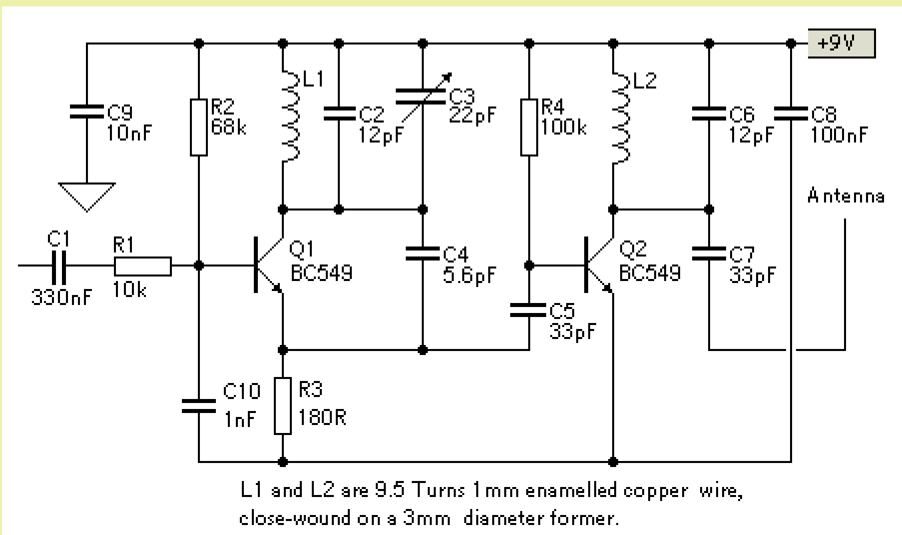
The 3v3 zener, diode D3 and 560k are not needed. Remove the three components and put a 220k resistor between the 330k and the base of the transistor. The 330k will charge the 33u and activate the relay. If you want to increase the time, put the 560k between the base and 0v rail.

Don't be fooled by a fancy-looking circuit diagram. They can also be filled with mistakes:



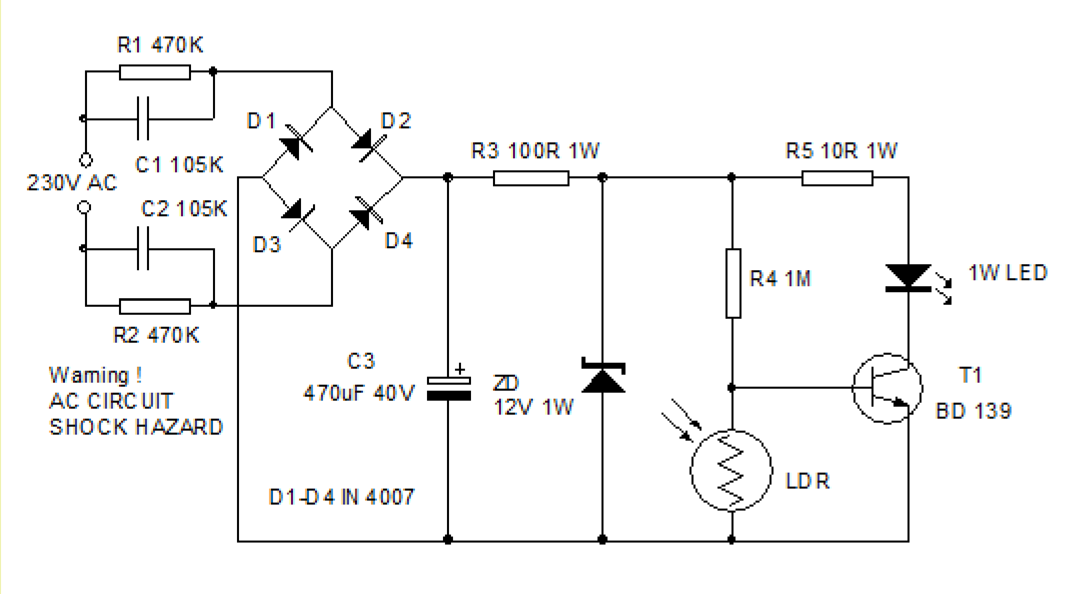
The voltage to pin 6 must be more than 60% for the gate to change state. The two 100k resistors only allow 50% and diode D1 reduces the voltage by 0.6v. The gate will not change state.
The 10n on pin 5 will not change the state of the gate because output pin 3 will prevent the change. The 1k on the LED will only allow 1mA.

RF AMPLIFIER:

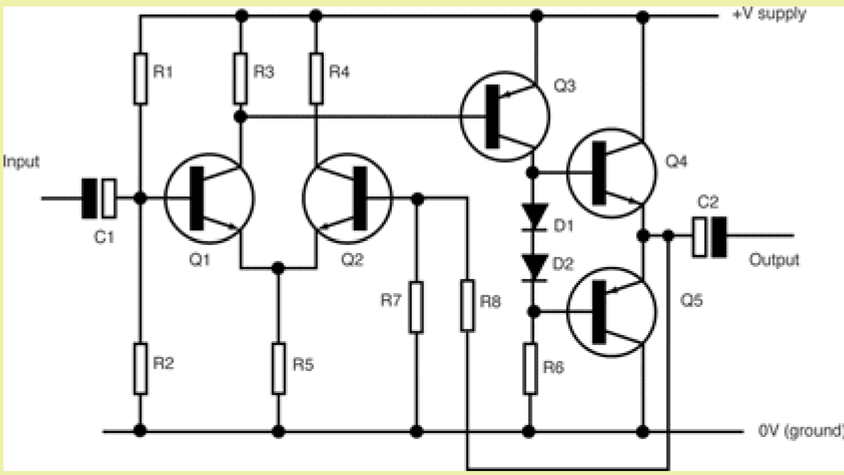


The tuned circuit for the oscillator stage consists of a tank circuit using a 9.5 turn coil and 22p plus 12p capacitor. The output stage is also a tuned stage and the coil and capacitor must have approx the same values so the circuit will operate at the frequency being injected into it via the base. If the output stage does not have a 22p so it can be tuned to accept the incoming frequency, the output of the transmitter will be very LOW. 1mm wire is very thick. 0.5mm wire will be more suitable. R3 can be increased to 470R to prevent overloading the transistor. C7 can be removed. C9 is not needed. R1 is not needed. C1 can be 100n. C8 can be 22n. C4 can be 10p.

How many mistakes can you get in a simple circuit?



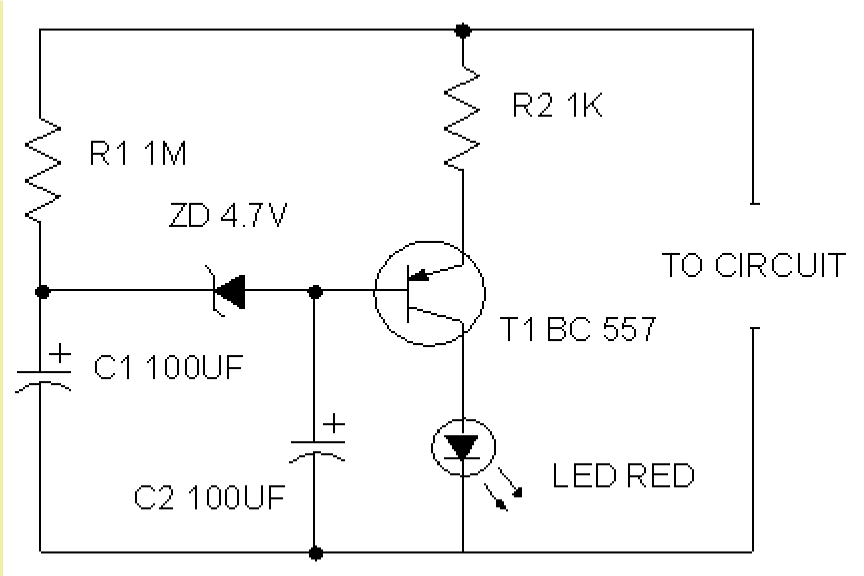
The 1u capacitors are in series and this reduces the current to 35mA.
The 1M resistor is too high. It should be 4k7.
The 10R resistors is not needed. The current through the circuit is limited by the capacitors on the input and the 10R has no effect.
The transistor can be BC547. The current is just 35mA.
The 1 watt LED will produce very little brightness with 35mA.



You can see why I always include component values on a circuit diagram.
The circuit above was taken from the web and no other data was available. The circuit is useless without the component values.
Anyone who produces a circuit without the values on the diagram is NOT an electronics person.
An "electronics person" can see how a circuit works by looking at the values and working out what is happening.
NEVER produce a circuit without the values on the circuit. If the parts list is separate, they can get separated on the web and all your effort is wasted.

POWER SAVING LED

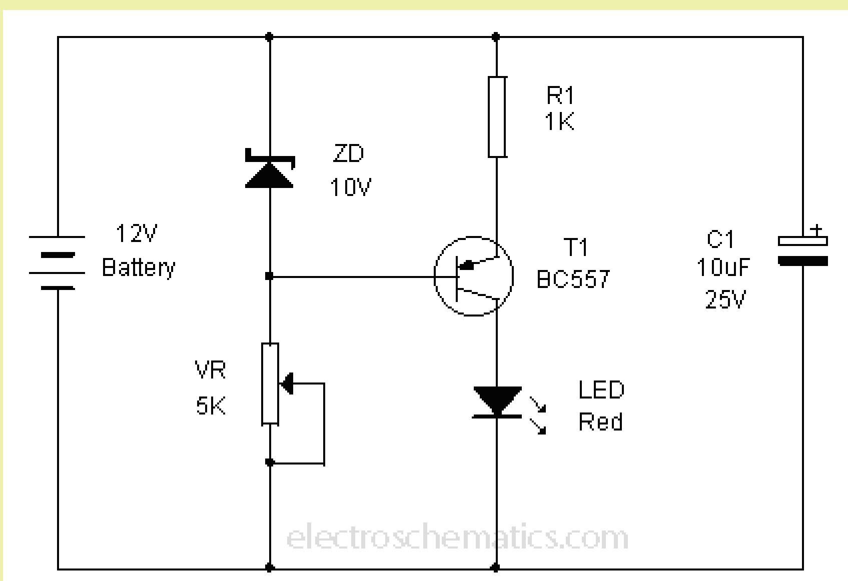
This circuit turns on the LED for a short time when the power is applied. Although the circuit works, the zener diode is fitted in the wrong direction for the 4.7v characteristic to have any effect and the zener is simply equal to an ordinary diode with a voltage drop of 0.6v.
This circuit was designed by Professor D.Mohankumar and he has absolutely no idea how a zener diode works.
This is not the first time he has designed a circuit using a zener diode in the wrong direction.
His ignorant reply to this was: "The circuit works and the discussion is ended." If that's what you get from a Professor who sends his junk circuits to **Electronics For You** magazine. It's no wonder Indian students cannot learn electronics.



When the circuit turns on, the first 100u electrolytic is charged via the 1k resistor, emitter-base of the transistor and via the zener diode fitted in the wrong direction so that it drops 0.6v. That's why the 100u charges very quickly and the LED comes on at the start.
The 100u stops charging when the voltage reaches about 1.2v from the supply-voltage as this is the total voltage-drop across the two junctions. At this point the transistor is still turned on and now the first 100u gets charged via the 1M and the second 100u gets charged via the 1k and emitter-base of the transistor. This creates an unknown time-delay because the circuit has not been put together as a proper time-delay arrangement.
Just because something "works" does not mean it has be designed correctly. You need to know what you are doing, if you don't want to make a fool of yourself.

BATTERY SELF DISCHARGE INDICATOR

Here's another one of Professor D.Mohankumar's disasters:



Apart from the fact that the circuit does not work, here is his explanation of how a zener diode works:

The Battery Self discharge Indicator circuit uses only a few components and its working is simple. A PNP transistor T1 act as a switch to light the LED, if the battery voltage drops below the safe level. The base bias of T1 is controlled by a Zener diode ZD. Its rating is 10 volt 1 W. The Zener diodes usually requires 1.6 volts excess than its rated value to enter into the “Avalanche state”.
So, as long as the battery voltage is above 11.6 (10+1.6), Zener conducts and keeps the base of T1 high. Since T1 is a PNP transistor, it will not conduct till its base becomes negative. So LED remains dark. When the voltage in the battery reduces below 11 volts, Zener turns off and the base of T1 becomes negative. T1 then conducts

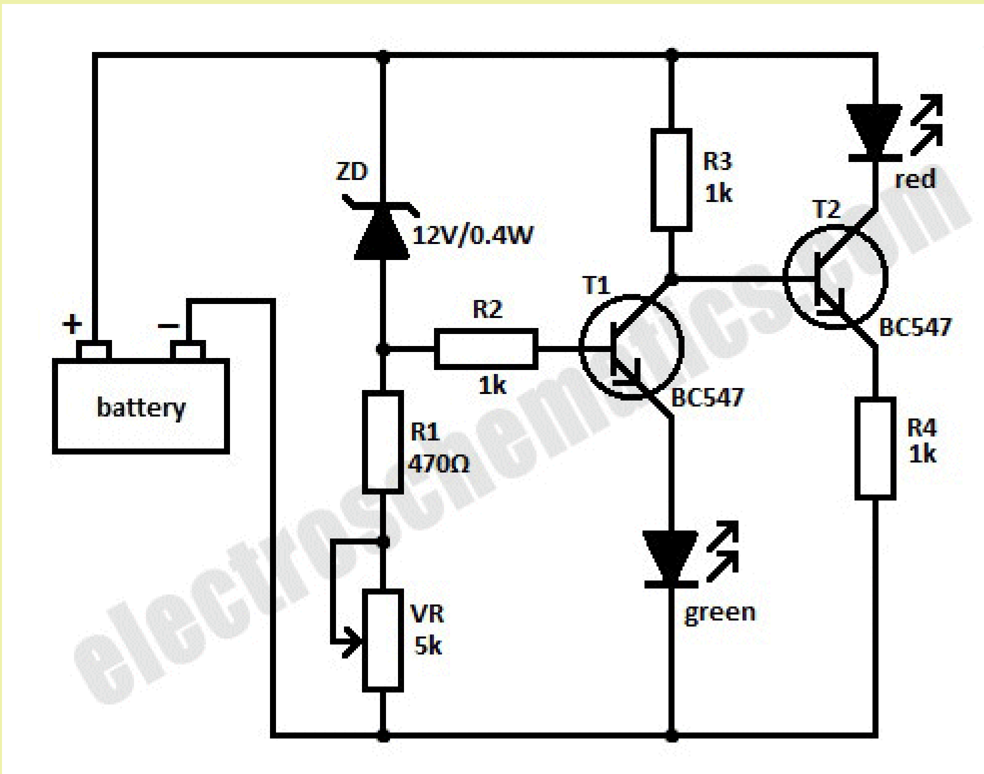
and LED lights. So the battery can be charged again to keep it in top condition. Preset VR can be used to set the exact point at which LED turns on.

Where does he get this rubbish from: *"1.6 volts excess than its rated value to enter into the “Avalanche state”.*

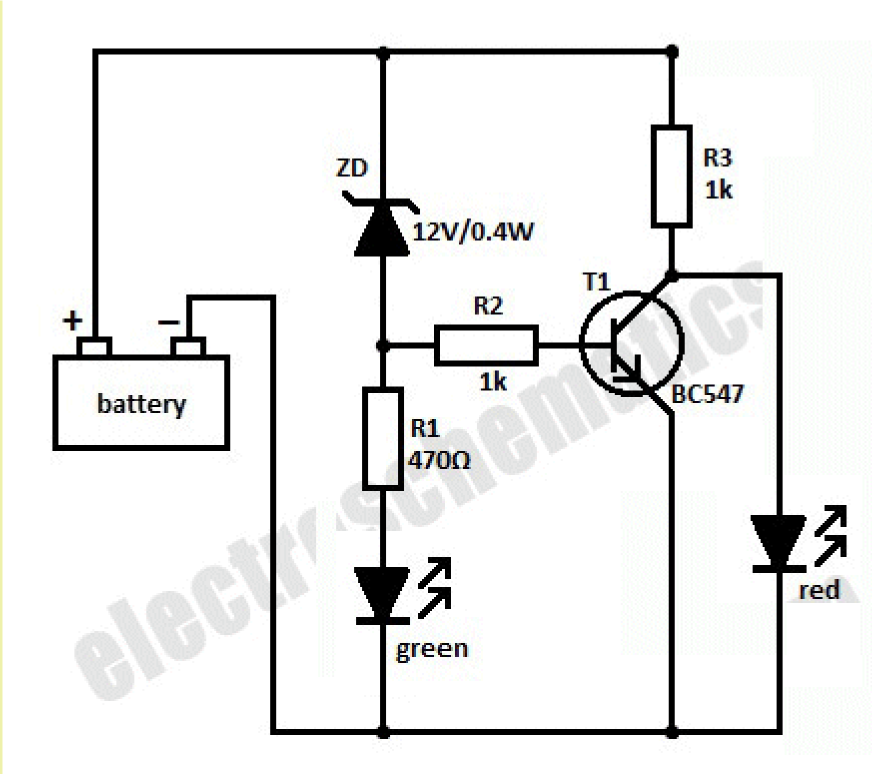
If the pot is tuned fully clockwise, the 10v zener will be directly across the battery and it will be damaged, as well as the 5k pot.

BATTERY INDICATOR

Here's another one of Professor D.Mohankumar's circuits:

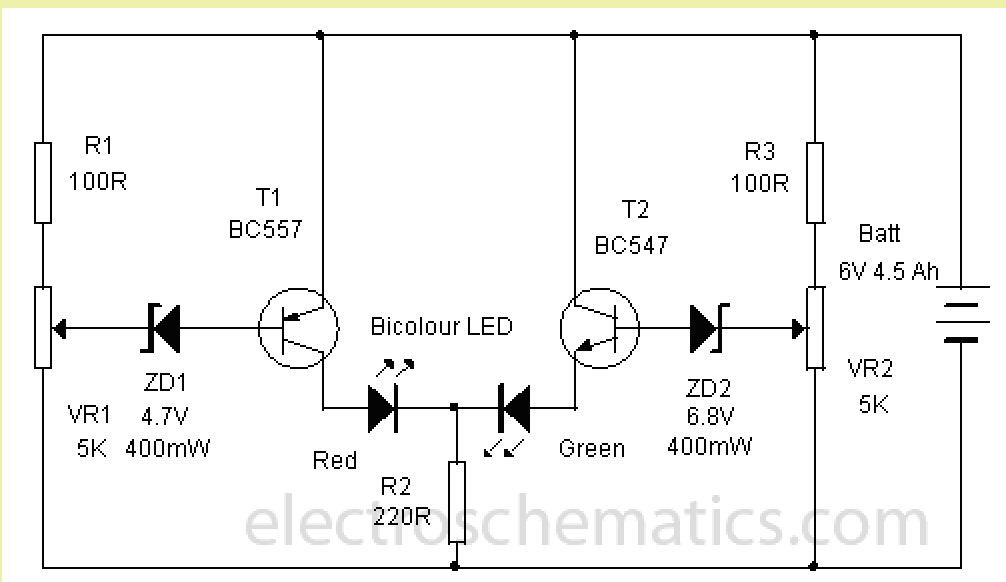


The 5k pot will have no effect and is not needed.
The green LED will turn on when the voltage reaches 12v + 0.6v + 2.3v for the LED = 14.9v This may be too hight for some batteries.
The second transistor is not needed. Here is a simpler circuit:



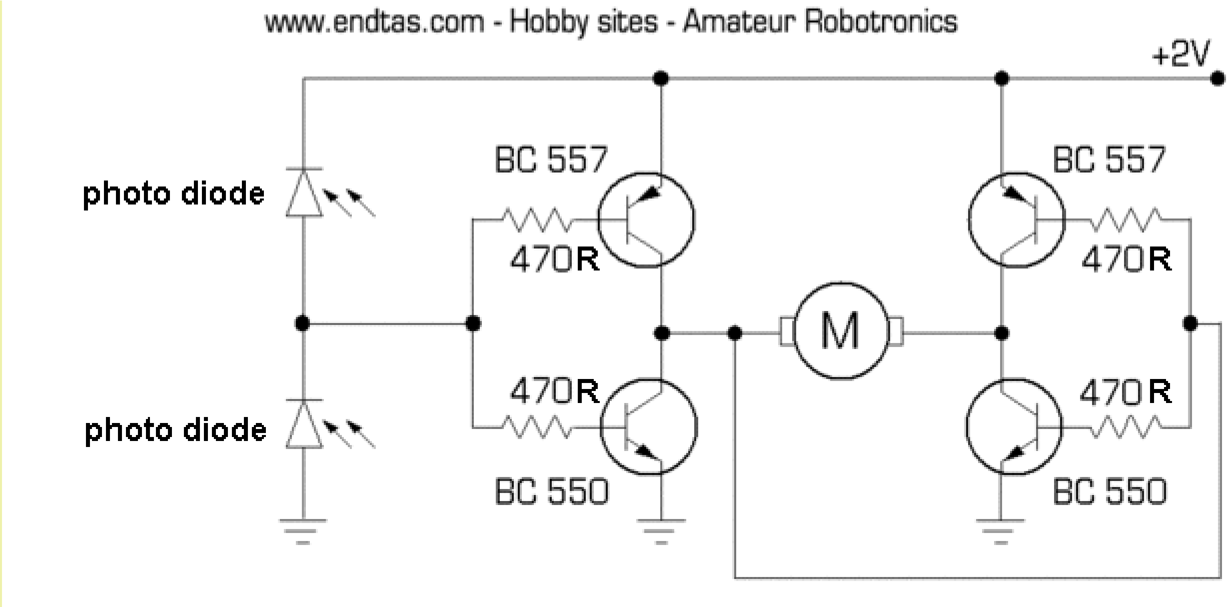
BATTERY CHARGE INDICATOR

Here's another one of Professor D.Mohankumar's circuits:



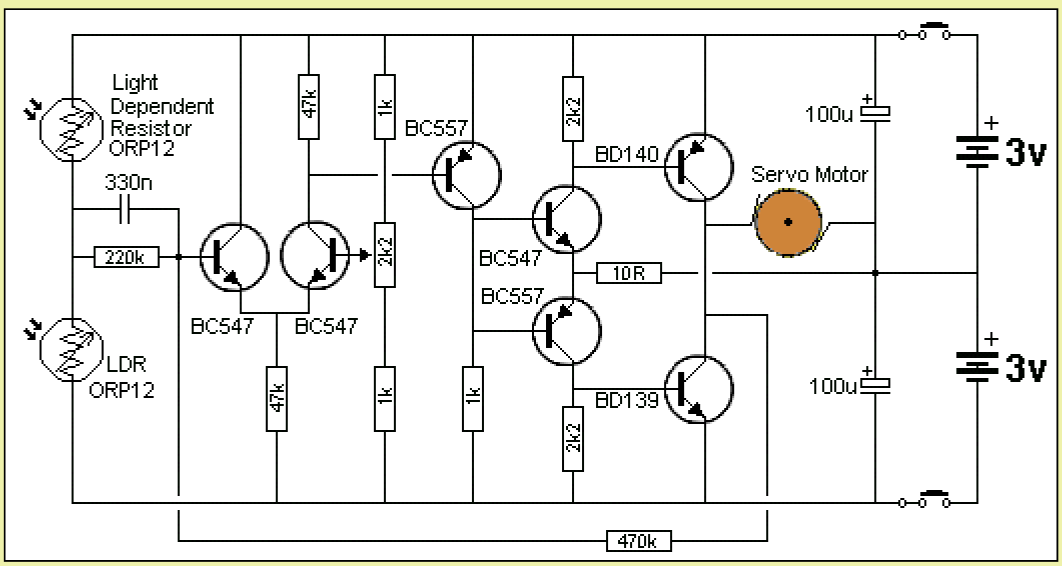
I wont go through Mohankumar's stupid description of the circuit, because the circuit doesn't work AT ALL.
Firstly, the 4.7v zener is around the wrong way. It is acting like a diode and will drop 0.6v.
Secondly, if the 5k pot is turned fully clockwise, it will be damaged as well as the transistor.
Thirdly, the green LED will never illuminate. It will take 6.8v + 0.6v + 2.3v = 9.7v
Doesn't he check or test ANYTHING?

Here's a circuit with a fault we have mentioned before:



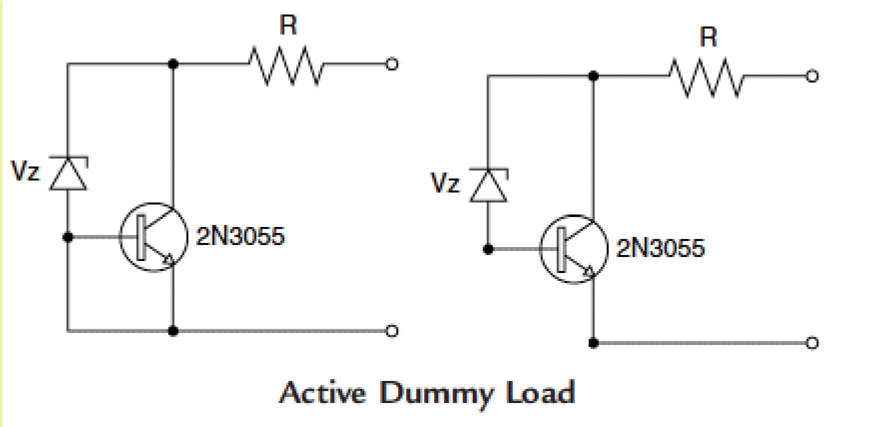
When both photo diodes receive equal illumination, both transistors are turned on and a short-circuit current flows through the collector-emitter circuits. At 2v supply, this current will not damage the transistors but it is wasteful current. In addition, the bridge will drop (lose) about 0.5v across each transistor and the motor will only receive about 1v.

The solution is the following circuit:
It uses a half-bridge to dive a motor in the forward/reverse direction. It does not have an "OFF" position.

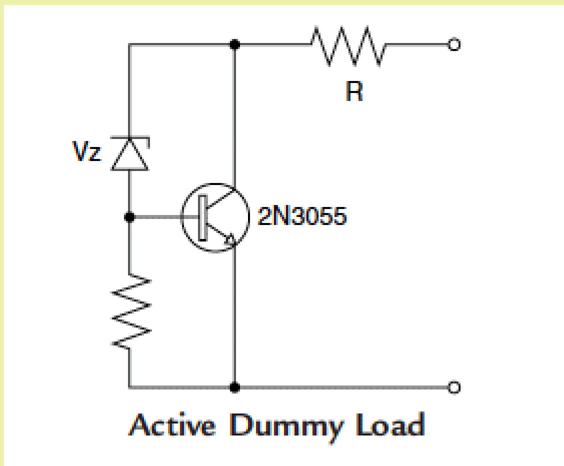


ACTIVE DUMMY LOAD

The circuit has a fault. The base is connected to the emitter. Simply removing the short-circuit is not an answer.

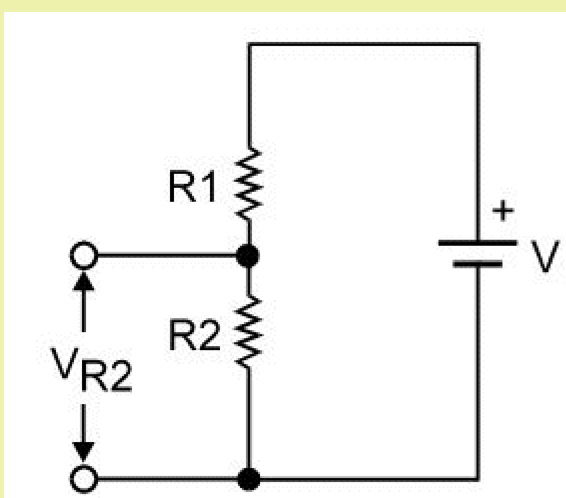


The zener needs a resistor to the 0v rail so it takes a small current and will break-down at the specified voltage. A lightly loading a zener will start to leak at a lower voltage than specified and the circuit will start to work at an unknown voltage-level. The corrected circuit is shown below:



I have come across another Indian Professor, who is telling his students all sorts of rubbish.
It is Professor **Vidyasagar Sir** and his website: Vidyasagar Sir's Electronics Web

Here is his explanation of the voltage divider:



Now the voltage across R2 is say VR2, which can be calculated as follows -

$$VR_2 = \left[\frac{R_2}{R_1} + R_2\right] V$$

VR2 = (R2/R1+R2).V

The formulae should be:

$$VR_2 = \frac{R_2}{R_1 + R_2} V$$

He also states:

Also there is only one problem associated with this circuit. This circuit has very high internal resistance, hence it cannot be used where you require large current along with the divided voltage….

This is NOT TRUE.

It should read:

Voltage-divider circuits can be very inefficient, depending on the load. If the load is turning on and off, the voltage divider circuit is the most inefficient way to power the load. But if the load is constant, you only need one resistor and the other resistor is the load.
Of course a voltage divider can be used with a large current and the wattage lost in the divider will also depend on the voltage being dropped across the voltage-divider-resistor.

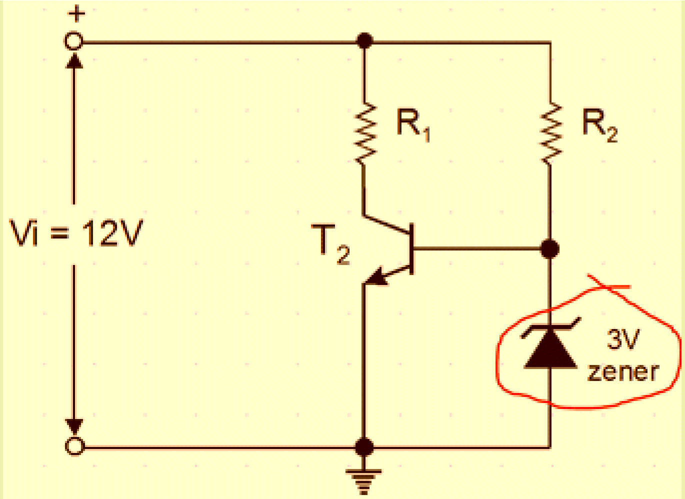
Professor **Vidyasagar Sir** has replied to me about the formulae. He still thinks his formulae is correct. Not only does he not understand electronics, but his mathematics is abysmal too. So far he has refused to change any mistakes on his site. Wait and see how things will change.

I now find he has **corrected** his formulae to the following:

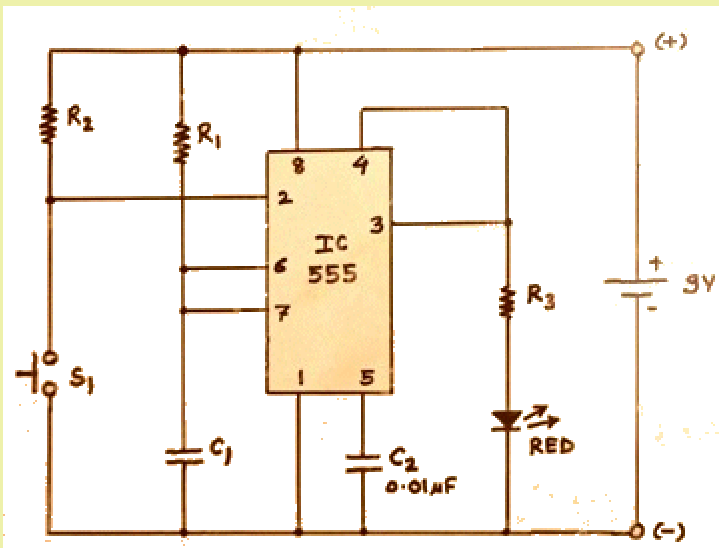
VR2 = (R2/(R1+R2)).V

How a "Professor" can make a simple mistake like this is beyond me. And then say his formulae is correct.
It was not until I explained the mistake in the finest detail and posted the ambiguity on this website, that the correction was made.
A lot of the other mistakes have magically disappeared from his website. At last he is learning.
He is still a disaster to behold. I cannot follow him around like "puppy-dog" and pick up all his mistakes.
He still has a very poor understanding of electronics.

Here is another total absurdity from Professor **Vidyasagar Sir:**
He says "the voltage on the base of a transistor can be raised to 3v."
I have made over a million projects (via Talking Electronics Magazine) and have never experienced a base voltage higher than 0.7v to 0.9v. I don't know where he gets this rubbish from.
With fundaments like this, It's no wonder Indian students get a shockingly poor education in their Universities.
Professor **Vidyasagar Sir** replied to me and said "of course you can raise the base to 3v. We tried it in our laboratory and it worked."

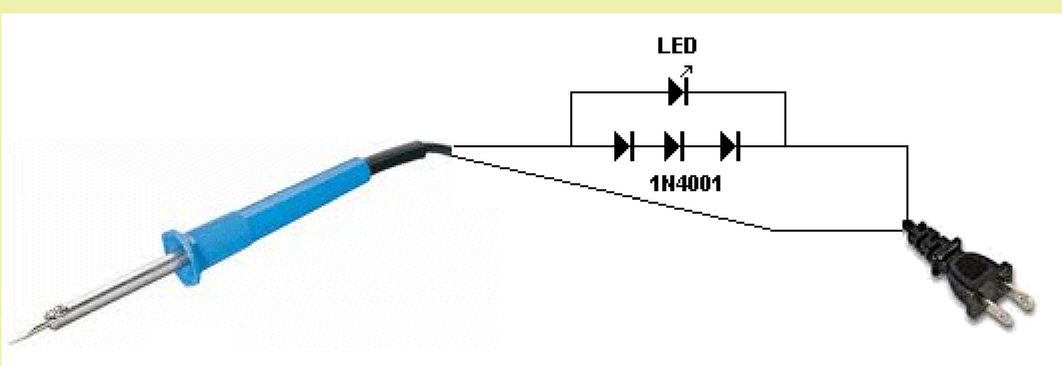


Here's another rubbish circuit from Professor **Vidyasagar Sir:**



He claims pin 2 will over-ride reset pin 4 and activate the chip !!!   I don't know where he gets this rubbish from. He may have a faulty 555 chip or pin 3 did not produce a LOW to put the chip into reset, but then he tells the world that this arrangement WORKS!!
It's a bit like the Pons Fleischmann cold fusion fiasco that turned out to be untrue.
But students are believing this idiot Professor and they will never succeed.
You say I am harsh. But if I was told rubbish like this; and made a fool of myself later in life, I would be furious.

Here's another absurd idea from Professor **Vidyasagar Sir:**
He suggests placing 3 power diodes in series on the 240v line to drop 2.1v so the LED will illuminate.

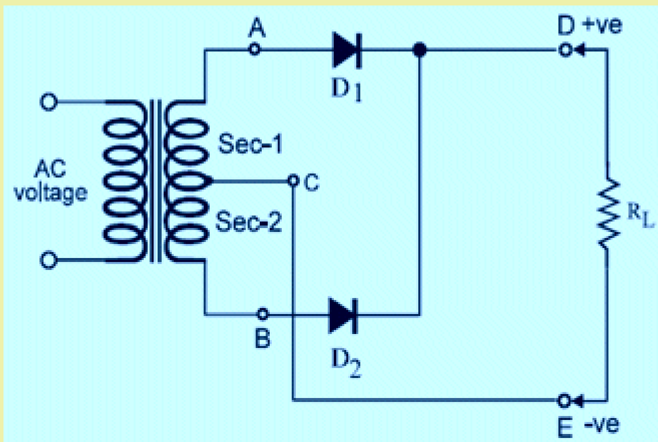


What an absurd idea. When the voltage reverses, the LED will see more than 300v and it will BLOW UP !
Vidyasagar Sir is a **Professor.** Where did he get this title from??????

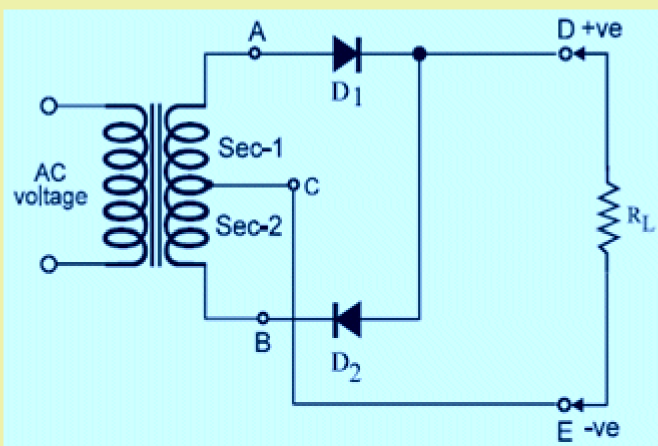
Another mistake:
"The element will get only half of the electrical power and thus, its life increases. Don't worry about the temperature…! The iron will be equally hot as it was getting previously."

This is NOT TRUE. The temperature of the tip will be considerably less if a 400v diode is used. I have done this with my **hot** soldering iron to reduce the temperature of the tip and it works perfectly.
This is another comment from Professor **Vidyasagar Sir** without any understanding of what he is talking about. He doesn't understand thermodynamics, electronics or mathematics. What a disaster.
The 1N4001 diode has a PIV of 50v. The 3-diode combination will provide 150v PIV and then breakdown, as the voltage rises, so the iron will **not** get half the electrical power. Don't forget, the peak voltage of 240v AC is 330v, so 150v will still allow a high percentage of the waveform to enter the iron.

Here's a question on a Power Supply test from Professor **Vidyasagar Sir:**



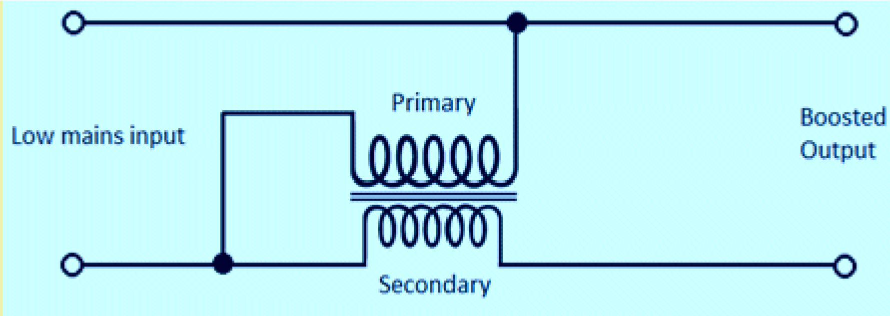
The question is: What will happen if one diode is reversed:



My answer is: the diodes will be damaged.
Professor **Vidyasagar Sir** says this is incorrect.

Of course the diodes will be damaged. The transformer has a short-circuit on the output and a very large current will flow. Where does he get his understanding from?????

Here is an idea from Professor **Vidyasagar Sir:**



Recommended transformer with its connections

The 240v to 50v @3amp transformer will increase the output voltage when the mains voltage is low.
He has never tried the circuit because he fails to mention that a 50v transformer will only produce 40v on the low input voltage (and less current) and the secondary winding has to be around the correct way to provide boosted voltage.
The transformer becomes an auto-transformer with an overwind.
You can also use a 240v transformer that has a 220v and 250v tapping.
Connect the 0v and 220v to the "Low Mains Input" and take the output from the 0v and 250v tapping. This will provide about 20v improvement.

Here is a comparison table for Power Diodes in a power supply from Professor **Vidyasagar Sir**:

Comparison of rectifier circuits –

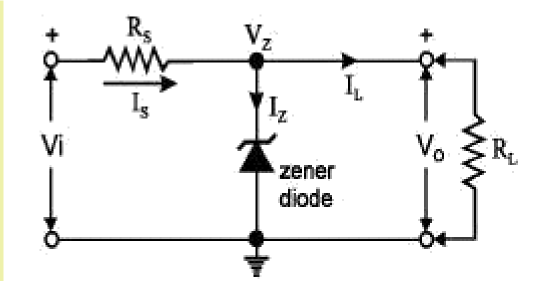
	Name	Half Wave Rectifier	Full Wave Rectifier	Bridge Rectifier
	Diodes used	One diode only	Two diodes	Four diodes
	Need for center tap transformer	Not required	Essential	Not required
	Current rating of diode	Equal to load current	Half of load current	Equal to load current

Why is the current rating of two diodes in a centre-tapped power supply only half the load current?
Each diode is carrying exactly the same current as a single diode in a half-wave arrangement.
It is absolute madness to derate a power diode in a power supply. Even though a diode may be carrying current for half the time, you cannot use a diode with a 50% capability. I don't know where Professor **Vidyasagar Sir** gets this false information from.

Shunt Zener Regulator by Professor **Vidyasagar Sir.**

It's no wonder Indian students don't understand electronics. Apart from his terrible English, he has no idea how to explain the operation of a circuit. He has not explained how the zener diode works and the last two sentences are gobbledygook:

The zener diode is connected in parallel with load. Hence, it is called as shunt regulator. When unregulated voltage (Vi) (from a rectifier circuit) is connected, the current (Is) flows through series resistor (Rs) and the zener diode operates in breakdown region. So we get Vz = Vo. This voltage remains constant even though the input voltage changes. The circuit is suitable for small output current, because the (Rs) is in series with (RL) and so the output current is less. But series resistor (Rs) protects the zener diode from burning due to large current.

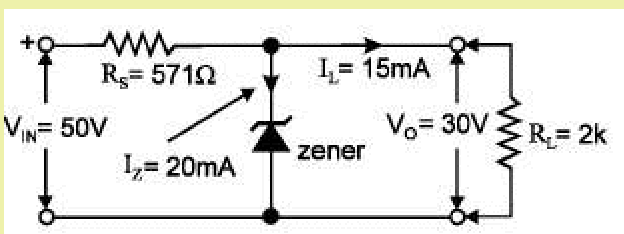


Here is a professional explanation, that I can understand, while using simple terminology.

We start with the load removed.
The input voltage passes through resistor Rs and the zener diode. When the voltage across the zener reaches the zener breakdown voltage, current flows through the zener and the reason why the voltage across the zener does not increase any further is as follows:
If the voltage across the zener increases, more current will flow through the zener and this will produce a larger voltage across Rs. This will reduce the voltage across the zener.
If the input voltage increases, the same reaction will occur and the voltage will remain stable.
If a load is connected, the voltage across the zener will decrease a very small amount and the zener will allow a lot less current to flow through it.
If more current is required by the load, it takes the current from the zener. This can be done until the zener is only passing a few milliamps.
As soon as the zener takes no current, (the current through the load increases further) the output voltage reduces and the circuit has dropped out of regulation.

Here is a question that shows Professor **Vidyasagar Sir** has no idea how a zener regulator works, or the fundamentals of mathematics.

A 30v, 600mW zener diode is used for providing a 30v stabilized DC power supply to a load. If the input voltage is 50v, calculate the series resistance Rs required for a load resistance of 2k.



Zmax = 0.02A, VRs = 20v, IL = 0.015A, Is = 0.035A, Rs = 571.43 ohm

The whole idea of a zener regulator is to provide for a fluctuating load. If the load is fixed, you don't need a zener. A simple voltage divider can be used.
This is a very bad test question. It does not ask the right questions.
Why have 20mA of wasted current flowing through the zener?
If the current through the load decreases, the zener will be damaged as it is already taking full current.
But the most disturbing aspect is Professor **Vidyasagar Sir's** lack of mathematical understanding.
You cannot provide an answer with a higher degree of accuracy than the supplied data. He has worked out the resistance to 2 decimal places (571.43 ohm) whereas the data provided has no decimal places. This is a fundamental mathematical concept and is just one of the areas where he fails to show competence.

A high voltage low current regulator power supply is required for an old tape recorder. The output voltage required is 500v and load current is 15mA. If Vin = 600v and Rs = 5k calculate the power rating of zener diode and current flowing through it.

Where can you get a 500v zener diode?

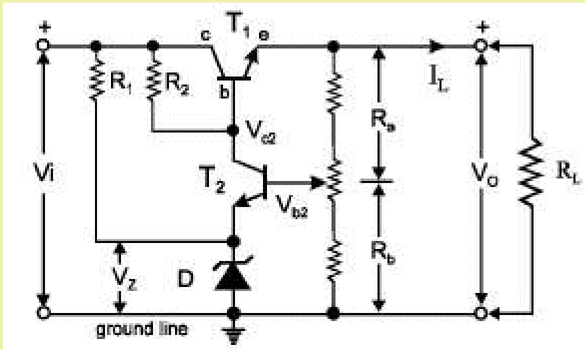
Here is another minor mistake from Professor Vidyasagar Sir

T1 is in series with the load, so it can provide large output current.
If the current through the load decreases, the output voltage will increase. It is quickly adjusted by the circuit and brought to normal value.

The process is as follows: If Vo increases, the voltage across Rb also increases i.e. Vb2 increases. So T2 is more forward biased. Hence, its Vc2 decreases. But Vc2 = Vb1, so Vb1 decreases. **Hence, transistor T2 is more reversed biased.** So its Vce increases. But Vo = (Vi - Vce) and Vi = constant, hence, Vo decreases proportionally and restores the output back to its original value.

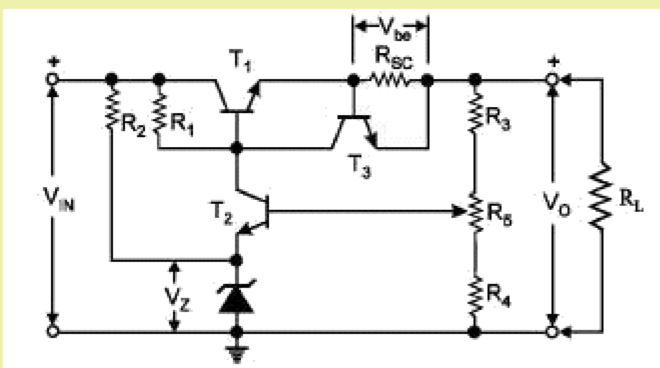
Obviously Professor **Vidyasagar Sir** means: **Hence, transistor T1 is more reversed biased.**

Using the terms FORWARD BIASED and REVERSE BIASED makes it very difficult for students to understand the operation of a circuit. As soon as you use terms like this, you turn the students OFF. Maybe this is why no-one has picked up the fault in the description.



He says he gets 5,000 visitors each day from around the world who hold high designations in Universities and colleges and yet no-one has picked up the numerous mistakes in his articles.
This articles is 10 years old and that means over 18 million people have visited his site and not a single correction has been made. He is obviously saying that University people don't have a real understanding of electronics either.

Here is another garbled and faulty explanation of how a current-limiting circuit works by Professor **Vidyasagar Sir**



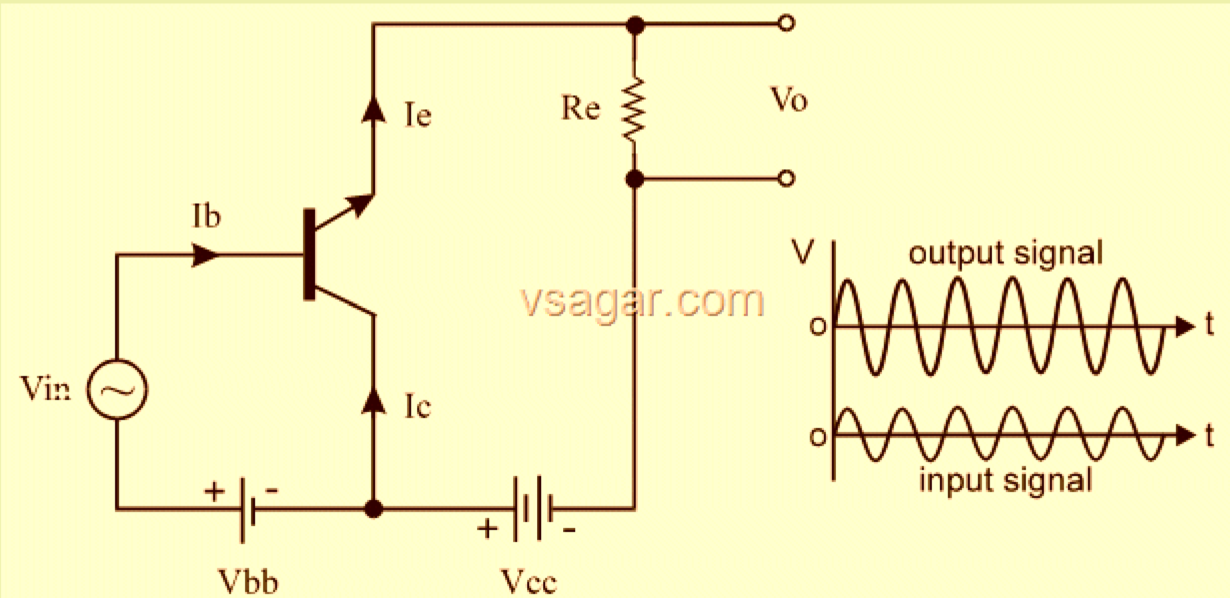
Working: here transistor T3 is a silicon transistor along with TI and T2. So it requires Vbe > 0.6v for forward biasing. A small resistor Rsc is connected between base and emitter of T3. Now the load current must flow through T1 and Rsc only.
1) Normal condition: When the load current through Rsc is less than a particular value (i.e. ILmax), which CANNOT produce 0.6V across base-emitter junction of transistor T3, so it is cutoff. In this condition, transistor T1 and T2 work normally and the circuit provides regulated output voltage.
2) If load current becomes ILmax: When the load current through Rsc is sufficient to produce 0.6v across it, T3 is forward biased. So its Vc3 becomes zero. But Vc3 = Vb1 = 0. Hence, T1 is cutoff. So Vce of T1 becomes equal to Vi. Hence, Vo = (Vi - Vce) = 0.
Since output voltage Vo is equal to zero, the circuit is almost in dead condition. The excessive current through T1 thus becomes zero and it is protected from burning due to excessive heat that may produce in it.

A number of inaccuracies are contained in the above description and here is an accurate description:

When the load current increases, a point is reached where the voltage across Rsc is 0.6v and transistor T3 turns ON and the voltage between its collector-emitter terminals will be very small. The actual value will be determined in a moment.

The condition of T3 turning ON will definitely occur when the output is short-circuited and the purpose of T3 is to prevent an excessive current flowing through T1 and damaging it.
T3 will turn ON and pull the base of T1 towards the 0v rail. T1 is an emitter-follower and the emitter will be 0.7v lower than the base.
The emitter of T1 must be 0.6v higher than the 0v rail, so current will flow through Rsc and keep T3 turned ON.
This means the base of T1 must be 1.2v above the 0v rail for the transistor to deliver the current through the sense resistor.
The current through T1 does not become zero, but the DESIGN VALUE. The value of current for which the circuit is designed to provide full output voltage before current-limiting starts to operate. You will notice Professor **Vidyasagar Sir** misses this point and this makes his description very inaccurate.

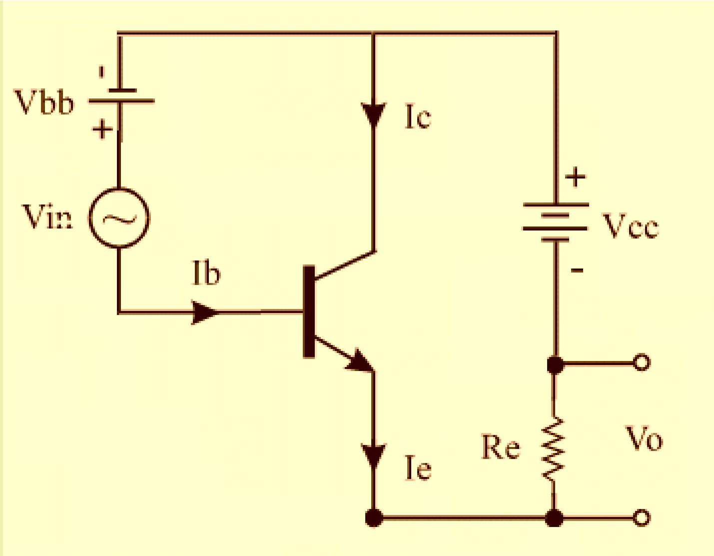
Here's another major mistake from Professor **Vidyasagar:**



Professor Vidyasagar's faulty interpretation of a Common Collector circuit.

It has more than 3 mistakes and he thinks a Common Collector arrangement means the collector is Common to the Input and Output and the Input must be connected to the collector. But the positive rail and 0v rail are considered to be "common" as far as a signal is concerned because the impedance (or resistance) between the positive and 0v rail is very small (via the power-supply) and thus the input is connected to 0v rail and the base. Both the 0v rail and supply-rail are considered to be "grounded" as far as a signal is concerned, meaning they both have zero signal or "ripple" on them.

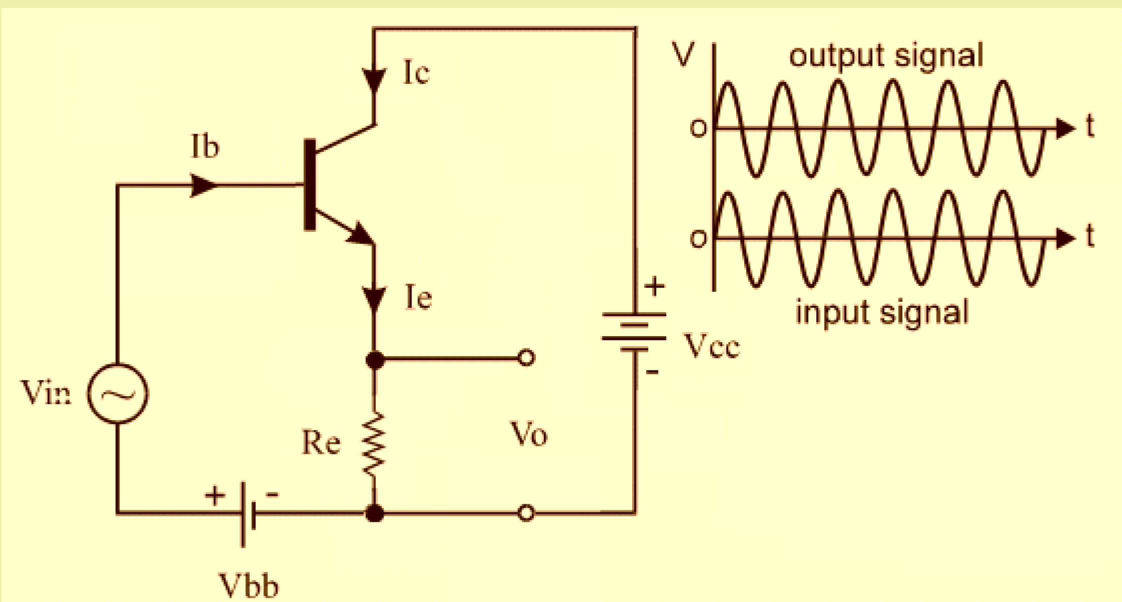
Here is his faulty diagram re-arranged so you can see the mistakes:



Professor Vidyasagar's faulty circuit re-drawn so you can see the faults.
Vbb is around the wrong way.
Vin should be connected to the 0v rail and not "high"
Re should be in the emitter circuit and not in the battery circuit.
Vbb should be connected to 0v rail and base via the Vin voltage source.

When you re-arrange the diagram to follow the conventional way to layout a circuit, you find it is not a COMMON COLLECTOR configuration. It is some RUBBISH that **Vidyasagar** has produced.
That's why I have always said: Draw a circuit in the conventional way so everyone can instantly see what is happening.

Here is the correct layout:



The correct Common Collector arrangement.

Note: the voltage amplification is almost equal to unity -
the stage does not amplify the voltage - only the current.

You will notice the output voltage is almost the same as the input voltage. In a Common Collector stage (also called an EMITTER-FOLLOWER STAGE) the output voltage follows the input voltage (but it is 0.7v below the input voltage) and is not amplified. Only the current is amplified.
Professor **Vidyasagar** says the voltage gain is **"medium"** whereas it is actually slightly less than 1.
It is obvious Professor **Vidyasagar:** has no idea what is doing and is a danger to be on the web. He should remove all his faulty diagrams and descriptions immediately.
How 18 million previous viewers did not see at least some of these glaring faults, it beyond me.
The fact is, very few people understand electronics. And when you draw circuits up-side-down and around the wrong way, you need to be a magician to rearrange them and see the faults.

Here's some more muddled paragraphs from Professor **Vidyasagar:**

Concept of feedback - connecting a fraction of output quantity back to input of a circuit is called feedback. Feedback is ALWAYS used in amplifier circuits.

There are two types of feedbacks: +ve feedback and -ve feedback.
When feedback is used in inverting amplifier, it is called -ve feedback and when it is used in non-inverting amplifier it is +ve feedback.

Feedback is NOT always used in amplifier circuits. It is only used to reduce distortion. He should say: Feedback is almost always used in Audio circuits to reduce distortion.
A much-better description of feedback is this: Feedback is taken from an output to a previous stage and if the feedback signal is out-of phase, it is called negative feedback. The out-of phase signal is designed to correct (or reduce) any of the highs and lows to reduce distortion. The overall effect is to reduce the amplitude of the signal. Positive feedback takes an output signal and adds it to a signal in a previous stage to INCREASE the amplitude of the signal.

The more you read Professor **Vidyasagar's** website, the more stupid it gets.
He concentrates on forward and reverse biasing of an NPN transistor as though both these conditions are important.
I understand the concept of forward biasing. It is turning ON a transistor by supplying voltage to the base.
But I have never reverse biased the base. There is no point in reverse biasing the base. Simply reducing the base voltage below 0.5v will prevent the transistor conducting
Professor **Vidyasagar's** talks about voltages and electrons in the same paragraph and I find it hard to understand what he is talking about, with his up-side-down diagrams.
And if his students understand his concepts, they certainly have not passed any corrections to him about the faulty lecture notes on the website.
Professor **Vidyasagar** has removed his lecture notes from the side because other site-holders have copied the notes and presented them as their own. You can locate these old notes by going to WAYBACK Machine - a website that archives websites so you can see the content from pervious years.

Vidyasagar Sir's Electronics Web website: http://vsagar.com/

INTERNET ARCHIVE WayBackMachine

[New pages will appear in a new frame.]

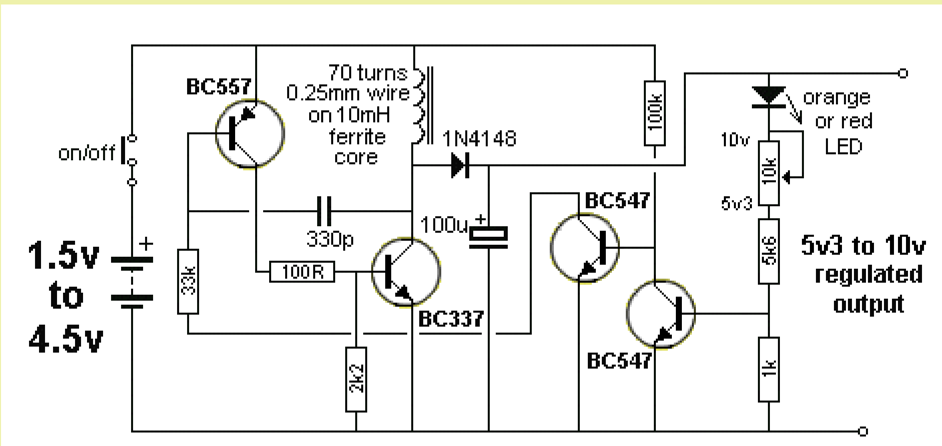
http:// Take Me Back

Professor **Vidyasagar** is a teacher and he should not be worried who copies the notes or what they do with them.
Things started off very cordially with Professor **Vidyasagar.** He acknowledged some of the mistakes on this site and said they would be corrected.
But when he realised I had located mistake after mistake, he started to take a different attitude. He took affront that I had dared to expose his superior knowledge with mistake after mistake and said many University lecturers had used his information in their lecturers and no-one else had detected any anomalies.
I am totally impartial as to who produces the faults and you will find the 15 previous pages of **Spot The Mistakes** come from many different sources.
But I get particularly annoyed when the holder of a website fails to correct the mistake on his site.
You will find this applies to people who think they are above correction.
The two most recent examples are: Professor **Vidyasagar** and Professor D.Mohankumar.
Neither of them have the faintest idea about electronic design and their only ability is to regurgitate theory that is already available on the web.
When it comes to providing their own understanding of a circuit, they fail TOTALLY.
They have done and said some of the most outrageous things I have ever experienced. But the worst part is: they claim it to be true and pass on their ignorance to unsuspecting students.
They become a danger on the web and it is fortunate they get a very small audience.
However even poisoning one student is a tragedy and hopefully these **Spot The Mistakes** pages will reach an increasing number of students and make them aware the web consists of a number of dangerous electronics

websites.

It appears that Professor **Vidyasagar** has now removed his website from the web. From his initial barrage of comments to me about how stupid I am - "**now I understand you are not just an idiot Australian**" to "Now you start drawing circuits of your own and trying to stick them on my name" to removing some of the faulty circuits and diagrams and descriptions - to removing his whole site.
If you look at his biography you will find he did only two years of a preliminary course in electronics and this is the main reason for his total lack of understanding.
When I first saw his circuits, I did not realise the faulty content because the word: "Professor" was splashed all over the page. But then I saw 3v on the base of a transistor. When he replied to my email to say: "of course you can have 3v on the base of a transistor," I started to realise something was wrong. How right I was.
It is best to have his whole site vanish, rather than have one incorrect circuit or statement to poison a student. And that's what has happened.
Some people are going for Monsanto with their criminal GM seeds, I am going for those who teach faulty electronics. And so far I have won on two accounts.

After a dozen or more mistakes sent to Professor **Vidyasagar,** he got rather irate and started to criticize my website.
He located this circuit: http://www.talkingelectronics.com/projects/5v/5v.html



and said "this circuit has never been tested practically, because a regenerative latch between the feedback of BC547 and BC557 will be produced." "Only an idiot can publish such nonsense circuit."

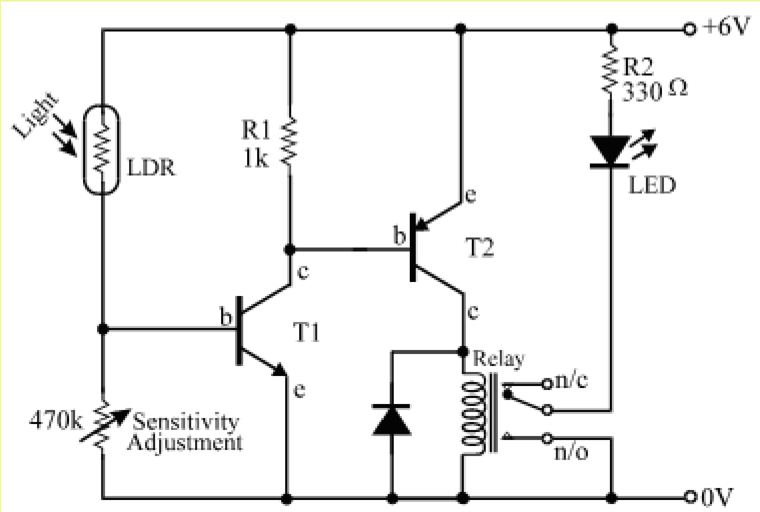
How wrong he is.

Firstly I NEVER put a circuit on my website before it has been built and tested. (I am not like him with his JUNK, untried, circuits.)
Secondly, the BC547 and BC557 will never feedback and produce "lock-up." The BC547 simply adjusts the bias on the BC557 (the current flowing in the base lead) and this has an effect on the frequency of the oscillator, made up of the BC557 and BC337.
The circuit works quite-well and produces a good (current) output from as little as 1.5v supply. See the link above for more details.

All the knowledge of "holes" and "electrons" (for the past 32 years) has not helped him understand how a circuit works. So, I ask you, why spend years learning the theory if you want to understand how to design circuits.
Recently, an 18 year-old school student devised an electrical cell and a program to detect all sorts of diseases in the body. Along with this a girl wrote a program to analyse X-ray scans to detect cancer cells. The tests are 2,000 times cheaper than present tests.
Where is their 32 years of theoretical knowledge? They have written programs that totally supersede anything currently available. Their skills have left the research scientists in total awe.

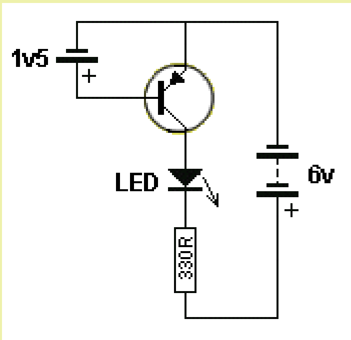
I have not had one single sensible comment from Professor **Vidyasagar.** From the circuits above, (that he has produced), I leave it to you to decide if you want a person like him to teach you electronics.
I certainly don't and if he were my teacher, I would be trying to get him dismissed.
He is a danger even walking the corridors of a University.
I have never experienced such incompetence before. And such arrogance, telling me: "Only an idiot can publish such nonsense circuit." If I could understand his English, I would tell what he is saying.

Here's a circuit from works supervised by Professor **Vidyasagar.**
The circuit has no current-limiting between the two transistors and if the LDR turns on with bright light, its resistance can be as low as 300 ohms.
This will allow 2mA to flow in the base of the first transistor and more than 200mA in the collector-emitter circuit.
This is obviously wasteful current and the students are not advised to add a current-limiting resistor to prevent excessive current-flow.
A very poor demonstration-circuit.



Here's an absurd description of Professor **Vidyasagar** telling a reader how to create a circuit with a PNP transistor:
"To operate the PNP transistor as a switch, connect a pencil cell across base(+) and emitter(-) and an LED in series with a resistor of 330ohms, in collector circuit. connect +ve of another battery of 6V across one terminal of this resistor and -ve to emitter.
Now when pencil cell is connected the transistor switch is ON, and when the cell is disconnected, the LED will be OFF."

Here's the faulty circuit:



Professor **Vidyasagar** never tests anything he says. He makes a fool of himself. The 1.5v cell is around the wrong way and the 6v battery is around the wrong way.

He gets his faulty understanding of how a transistor works from his theory article:

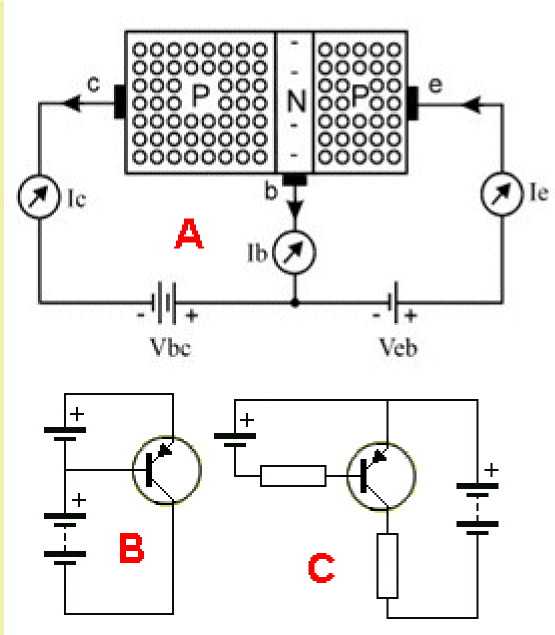


Figure **A** is a bad representation of biasing a PNP transistor because the two batteries are "fighting each other" due to the different currents flowing and there are no current-limiting resistors to prevent the junctions being destroyed. It has been redrawn in diagram **B** to show the faults.
The correct circuit is shows in diagram **C**.

He states: Personally, I hate PNP transistor, its overall working and even using it in any of my projects and circuits. This is because, its working is very difficult to understand.
Here is his photo:


Dattaraj Vidyasagar

If he doesn't understand how a PNP transistor works, how can he possibly explain its operation to his students!!

Here is part of his biology:
What makes me the expert? EXPERIENCE! I have 32 years of practical experience in my fields… including Electronics.
How can you say you are an expert, when your website is filled with mistakes?
Not only that. You fail to remove the faulty items when they are pointed out to you.
You have absolutely no regard for visitors to your website. You don't even have the decency to make the corrections.
With 3 qualifications in electronics it shows how perfunctory these qualifications are. He cannot even draw a circuit correctly, wire a 555, bias a transistor or correctly analyze one of my circuits.
This makes two electronics professors with exactly the same incompetence.
It proves it is very easy to regurgitate theory to a class of students without having any electronics ability AT ALL.
This also proves the fact that it is not necessary to know all the atomic fundaments of the structure of the atom to become an electronics design engineer.
It's wonderful to know the structure of a transistor, but it is not needed. There is a limited amount of time in the day and you need to learn as much as possible to equip yourself for a career in electronics. And that involves knowing how to **design** and how to **fault-find**. All the rest is a bonus and can be learnt AFTER the essentials are understood.
Universities have everything around the wrong way. They expect you to be a research-scientist and not a down-to-earth design-engineer.

Up to now, neither has fixed the faults on their website, however Professor D.Mohankumar has given up sending

out weekly circuits containing his absurdly faulty, untested designs.
It is hoped Professor **Vidyasagar** will also cease displaying his ineptitude with electronics. He is just a danger to budding electronics enthusiasts. The latest news is positive. It looks like Professor **Vidyasagar** has ceased putting his faulty discussions on his website.
This makes 3 website-owners come to grips with the fact that they don't have the capability to inform and assist others in the complex world of electronics.
My campaign goes back over 20 years where I bought text books and made corrections to the text and circuits and sent the copy to the publishers. Fortunately the books were never reprinted.
One visitor emailed me today and asked if the comments on this section had been tried and tested. He says:

Firstly I would like to thank you for your wonderful website , especially the section of Spot the Mistakes and the section on FM transmitters.
I just wanted to confirm one thing. While you are criticizing and finding faults in the various circuits available on the web and in electronics magazines and in most cases giving the rectifications, do you yourself test your suggested changes and try out before putting them on your website ? Or are they just suggestions or try outs?

My reply: I can see if a circuit will work or if it will not work.

I have already mentioned this point before. As you become more capable in the electronics field, you can "SEE" a circuit working in your mind and you can see what is happening. It's a bit like putting a circuit in a simulation package and watching it operate.
This is what I have been doing 20 years before these packages were invented. Although I cannot see the operation of ALL circuits, I concentrate on those I am familiar with and these pages reflect that capability.
However it is most important to have the component values on the diagram. I cannot works with blank values. It is the values that let me know what is happening at each junction of the circuit.
I am not "Mr Magic" I don't make things up. The circuit values produce the results, however I don't put a new circuit on the web without firstly building it and testing it. That's why I know the 3v to 10v power supply circuit above has no faults. It has been built and tested and photographed.
I am not doing this to better my cause. I am doing this to show a completely new way to master electronics.
I already get hundreds of emails from readers who have read my books and magazines over the past 30 years and say my approach changed their life.
My approach works. It doesn't supplant an education but is a precursor or preliminary suggestion, before taking up a course. It's a bit like sharpening your colour pencils before taking art class.
You should have made dozens, if not hundreds of projects before starting a course. To think you are going to learn electronics in a course is like thinking a CRO will show you the fault in a TV.
It just doesn't work like that.

Here's some more stupid things from Professor **Vidyasagar's** website:

In forward biasing of NPN transistor its collector base junction is ________ biased.
The collector-base junction is never considered when biasing an NPN transistor.

The phenomenon of negative generally occurs in:
Rectifier diode
Tunnel diode
Zener diode
Gunn diode
Negative what?????

Resistors R1 and R2 – 470 ohms (if transformer rating is 100mA. However, if it is 250mA or 500mA, then use strictly a value of 1kohms.)
The current rating of the transformer has nothing to do with the value of R1 and R2. It does not matter if the transformer produces 100 amps!!! - you can use 470R. How little Professor **Vidyasagar's** understands.

Professor **Vidyasagar** connected an 8 ohm speaker to the output of a 555 via a 100u electrolytic and created a 1kHz tone. He wondered why the circuit did not work very well.
The capacitive reactance of the 100u at 1kHz is less than 2 ohms and the 8 ohm speaker makes an output of 10 ohms. With a supply of 6v, the output current will be more than the 200mA capability of the chip. (It will theoretically be 4v /10 = 400mA). He then put the chip on 12v !!! Another dumb thing to do.
Doesn't he know anything about capacitive reactance??????

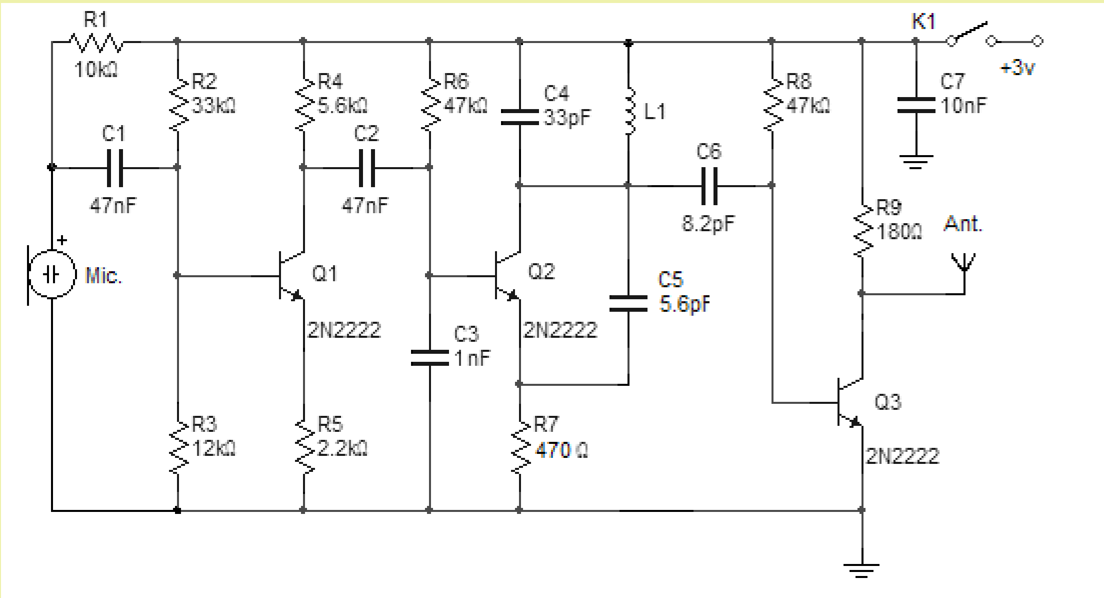
Why only 5kiliohm resistors (the three resistors) are used in the internal circuit of IC555?
What is a kiliohm????

"If the wire is 1 sq. mm. in diameter"
How can you get one square millimeter in diameter????? He means one square millimeter in area.

He suggests putting a diode in series with your room lights to make them last longer. The bulbs will be getting only each half cycle of the AC and the filament will not be as bright. He suggests using a 100 watt in place of a 40 watt to retain the brightness.
But he fails to mention the fact that the bulbs will have a flicker that will be very annoying.
This is really a silly suggestion.

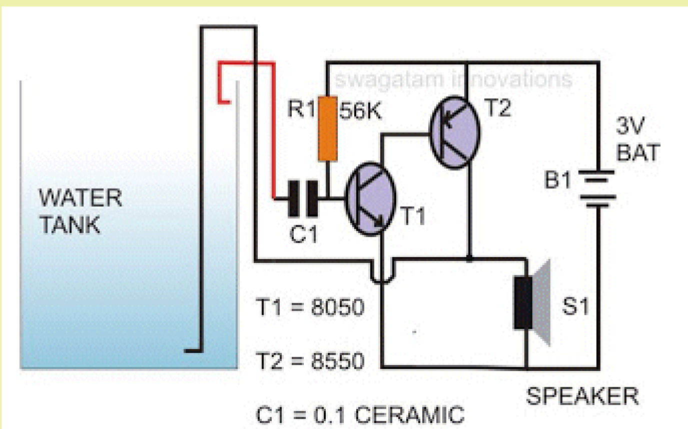
I could go on all day, trying to worm my way through the poor English on his website and trying to fathom out what he is trying to say.
I find his site frustrating; imagine an Indian student. He doesn't have a chance. And yet Professor **Vidyasagar** says Indian Universities are the best in the world.
I will leave it to you to decide.
Just go to his site: http://vsagar.com. It's a "dog breakfast." No index and it's impossible to find something the second time.

Here is a circuit of an FM transmitter from: http://www.hobby-hour.com/electronics/wireless_microphone.php



It is pointless having a stage that produces a gain of 2. The first transistor is in a bridge arrangement and the collector resistor and emitter resistor determine the gain of the stage. In this case it is 5.6/2.2 = 2.5!!

This is a terrible circuit:



FAULTY RAIN ALARM CIRCUIT

When the water is low, the circuit will not produce a tone but the first transistor will be turned ON and this will turn ON the second transistor and produce a constant high current through the speaker.

In addition, this type of circuit will not self-start when the power is already connected and the water rises.
It needs a "spike" from the power rail to start the oscillating process as the capacitor must be fully discharged to pull the base low to start the cycle - a very important point to remember.

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SPOT THE MISTAKES!

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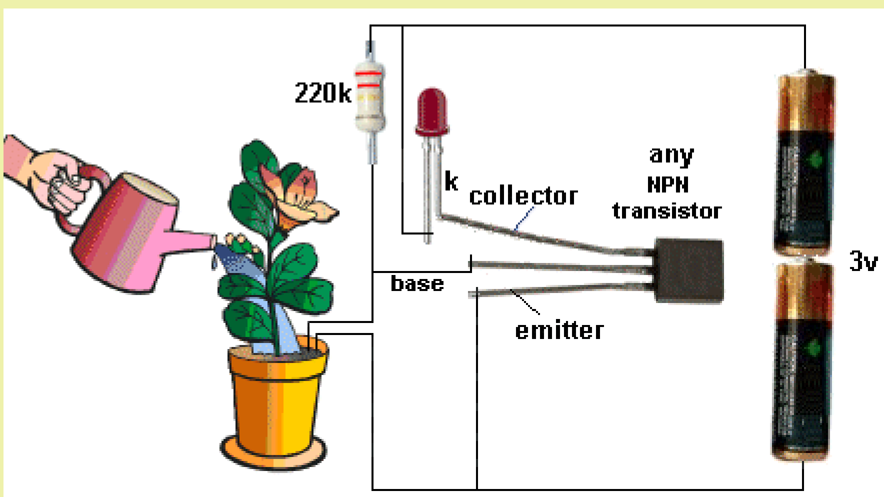
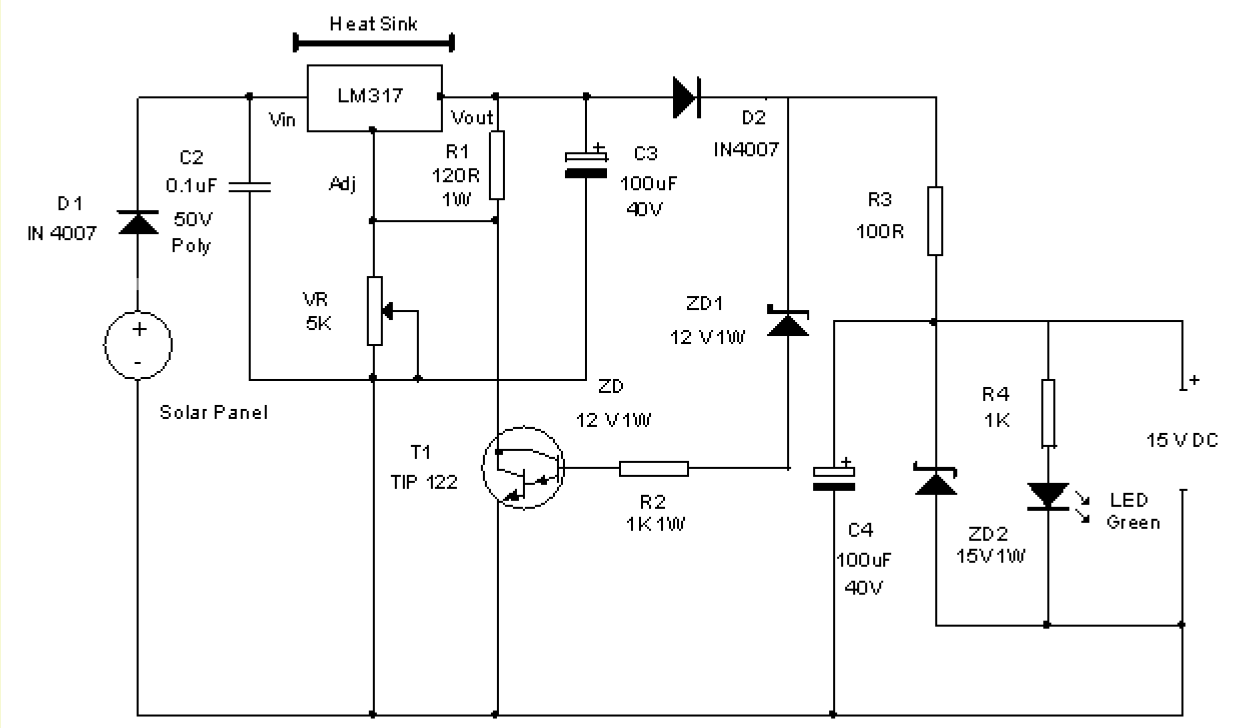
It is surprising how some electronics hobbyists and those working in electronics, can exist in this field with a faulty or limited knowledge of electronics.
I take the example of an electronics forum where a reader asked a simple question about a LED and dropper resistor. He provided a circuit and wanted to know why the base resistor was so high.
Here is the circuit:



None of the "panel of experts" explained how the circuit works. None of them noted the absence of the current limiting resistor for the LED or the reason why the base resistor is so high.
The transistor is turned on very lightly. It will amplify the current though the 220k resistor by a factor of say 200 (the gain of the transistor) and this will be equal to putting a 1k resistor in the collector circuit. The current will be only 1mA to 2 mA.

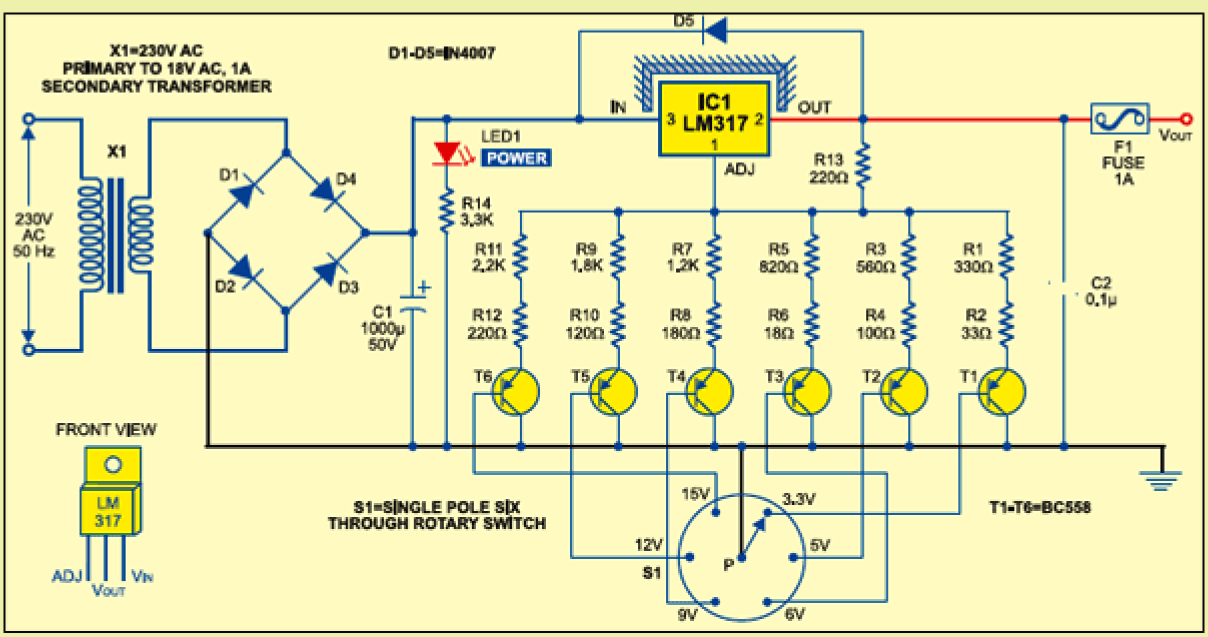
Here in another of professor D. Mohankumar's circuits:
We are not going into the operation of the circuit because it DOES NOT WORK
However here are some of the faults:



Diode D1 only needs to be 1N4004.
T1 does not need to be a power Darlington transistor. It can be BC547.
The output voltage will never reach 15v. The Darlington will turn on when the output voltage is 11.5v + 1.2v = 12.7v.
Yes a 12v zener starts to "leak" at 11.5v. No-one has ever told you that a zener starts to turn ON at a lower voltage. That's why they cannot be used in a circuit as shown above. You need a resistor between the anode and 0v to remove the leakage at 11.5v and wait for the major breakdown at 12v.
The output will NEVER rise above 12.7v
Suppose the circuit is supplying 100mA to the battery. The voltage drop across the 100R resistor will be = 0.1 x 100 = 10v !!
Can you see how absurd this circuit is?
It has never been tried or tested.

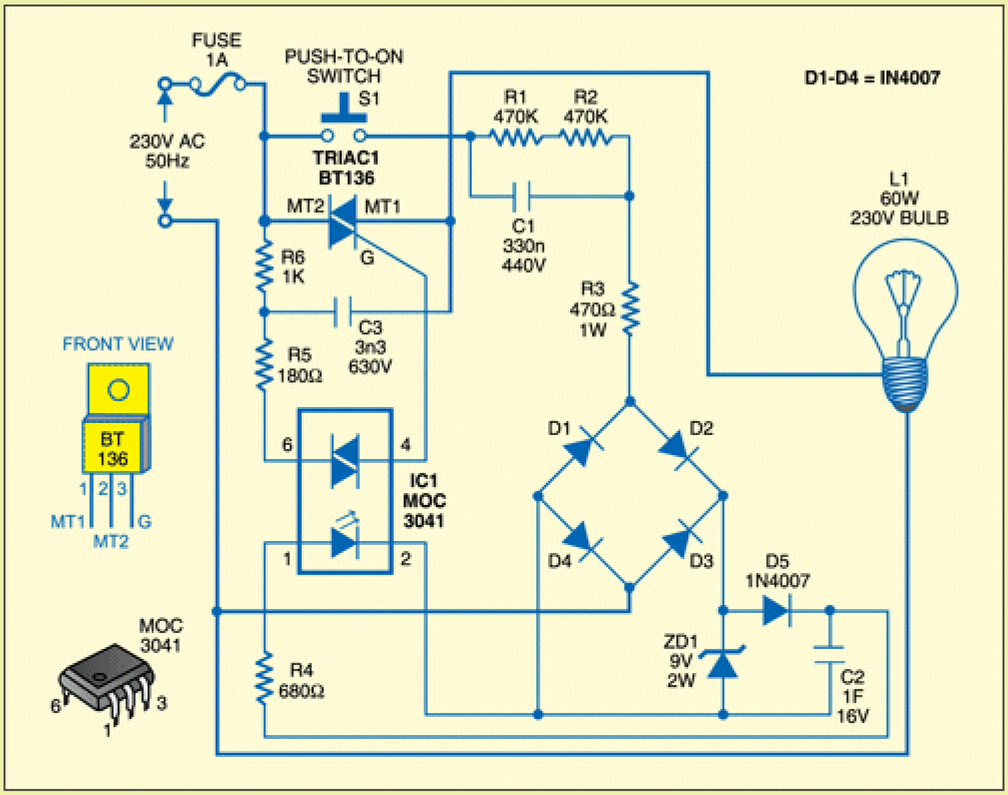
DANGEROUS POWER SUPPLY

This circuit is the most dangerous Power Supply you can get:



When the switch is changed from one voltage to another, the output instantly increases to more than 18v and will blow up many circuits.
The BC557 transistors are not needed as the resistors can be connected to the 0v rail via the switch.
However the 220R resistor (R13) is the resistor that should be changed and the circuit needs to be totally redesigned.
This circuit comes from **Electronics For You**. This Indian magazine is fooling the readers by saying they have electronic engineers and have tested the circuit.
I have asked for the names of the "electronic engineers." They have NONE.
It's rubbish like this circuit that makes **Electronics For You** a total failure as a magazine. They don't have anyone to check the accuracy of a circuit and "just because it works" they publish it.
Both Professor **Vidyasagar** and Professor **D.Mohankumar** supply projects to **Electronics For You** and we have shown how incompetent they are. Professor **Vidyasagar** has now removed his website completely from the internet, after I sent him over a dozen emails with his faulty reasoning and circuits that don't work. At least he has woken up to the fact that you can't fool "ALL THE PEOPLE ALL THE TIME."
D.Mohankumar's website

Here's another impractical circuit from **Electronics For You:**



This circuit allows you enough time to reach your bed and lie down before the bedroom lamp switches off automatically.
Mains power supply is reduced by the capacitive dropper arrangement. A 1F capacitor (C2) handles the timing part. When switch S1 is pushed to 'on' position for a few minutes, bulk capacitor C2 charges and the stored energy drives the internal LED of IC MOC3041 through resistor R4.

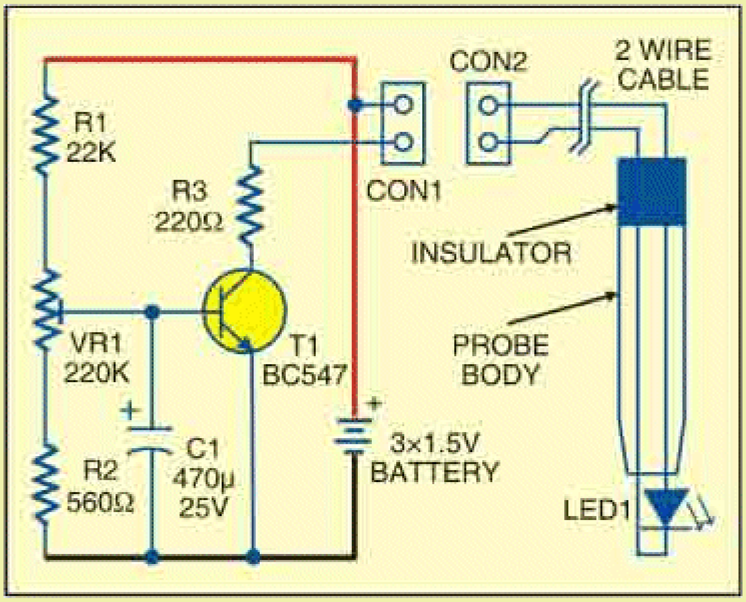
Who is going to push the switch for "a few minutes"
1F @ 5.5v is $3.00 to $19.00 depending on the supplier. eBay is the cheapest - it always is.
Where can you get a 1,000,000u (1F) capacitor @16v ??

The circuit only charges the supercap to 8.5v and thus half the possible energy is wasted. The only 1F @16v supercap on the web is very large and costs about $100. What an impractical circuit. Doesn't **Electronics For You** test anything?

1F capacitor can store one coulomb of energy @ 1v. Thus 1F @ 5.5v supercap can store 5.5 coulombs of energy.
But it can only be discharged from 5.5v to 2v (as this is the characteristic voltage across a LED). Thus the cap can supply about 3 coulombs.
1 coulomb is 1 amp x 1 second
If we allow 20mA for the LED, it will be illuminated for (3 x 1,000) / 20 = 150 seconds.
It will take as long to charge the supercap as discharge it. The charging current is about 20mA and the 9v zener does

not come into operation until the cap sees 8.4v.

Here's another circuit that doesn't work, from **Electronics For You:**

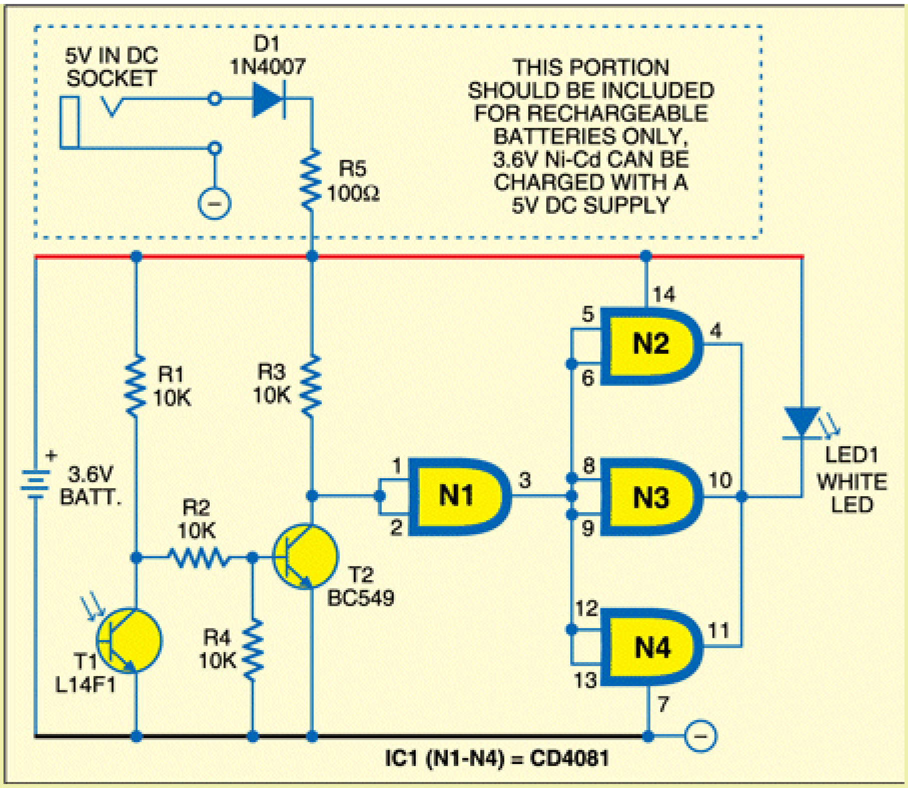


The transistor controls the brightness of the super-bright white LED in the tip of a pen.
The article states:

The ultra-bright LED requires up to 20 mA for full brightness. So there is no need for a separate on/off switch. Disconnecting CON1 from CON2 is enough when not in use.

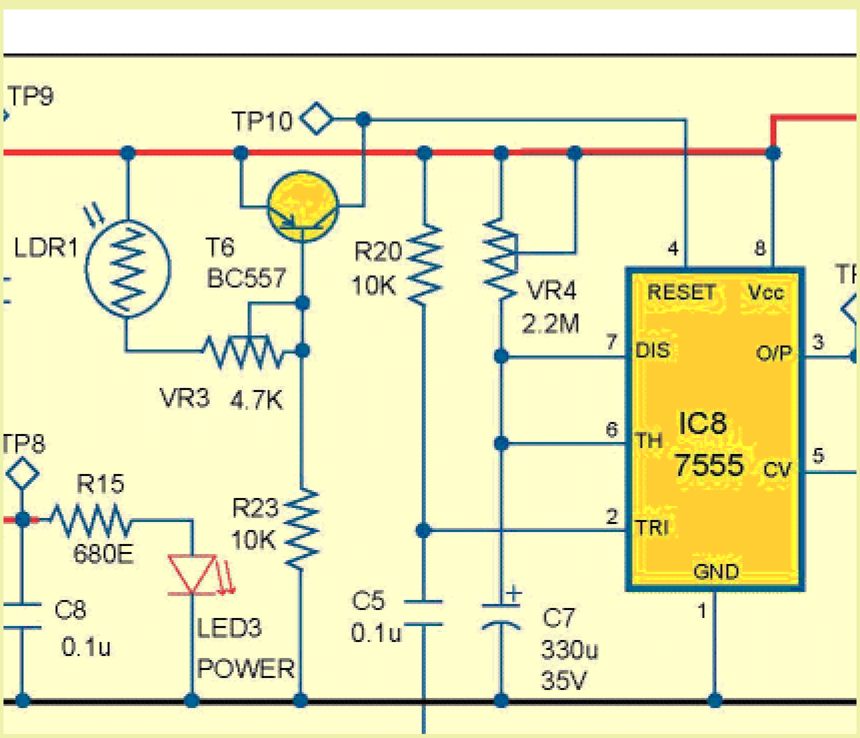
Two major faults with the circuit:
1. Current will flow through the 22k and 220k pot and 560R resistors when CON1 is removed and the battery will go flat.
2. The maximum current through the 220R resistor will be:
The voltage across the white LED is about 3.2v. The voltage across the collector-emitter of the transistor is 0.2v so the voltage across the 220R will be 4.5v - 3.2v - 0.2v = 1.1v
The current through the 220R will be 1.1 / 220 = 5mA !!!!
Another untested circuit from **Electronics For You.**

Here's another stupid circuit from **Electronics For You:**



The LED illuminates when T1 is not illuminated.
Two major faults:
1. Current will flow through the 10k and T1 when illuminated (about 3mA) and this will flatten the battery.
2. What is the purpose of the IC ???? It serves NO purpose. Simply connect the LED to the collector of the transistor via a low value resistor.
Another pointless circuit from **Electronics For You.**

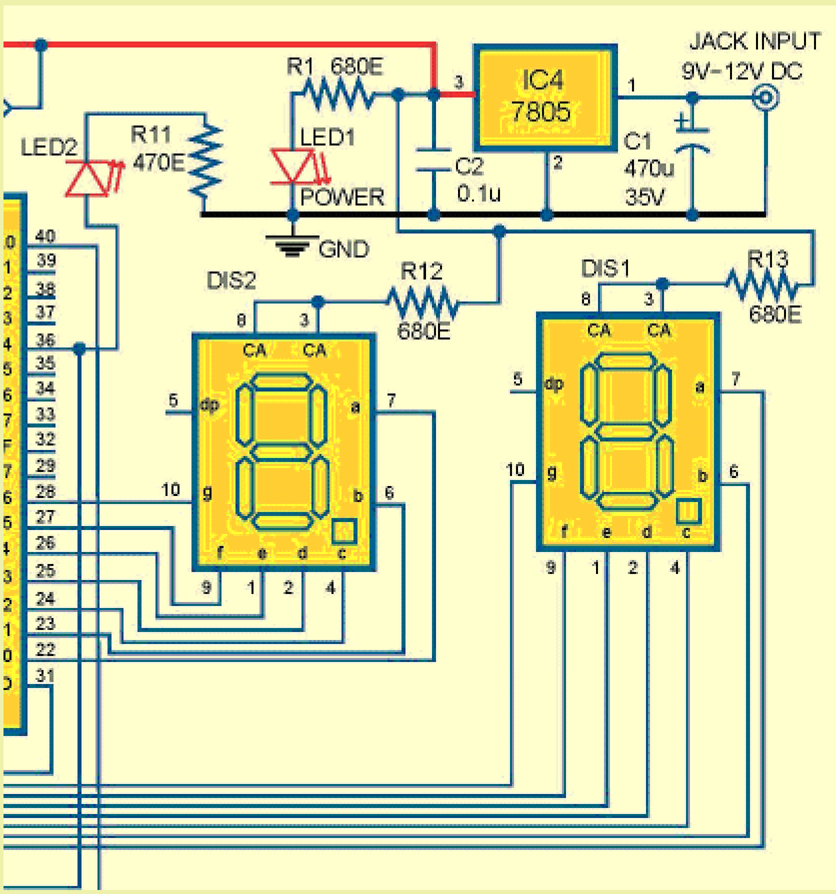
Here's another fault from **Electronics For You** (April 2013 issue)**:**



The reset-line of a CMOS 7555 IC is connected to the gate of a FET and it requires almost no current to provide the reset feature.
The reset line is active LOW and this means any voltage above about 1v DOES NOT reset the chip.

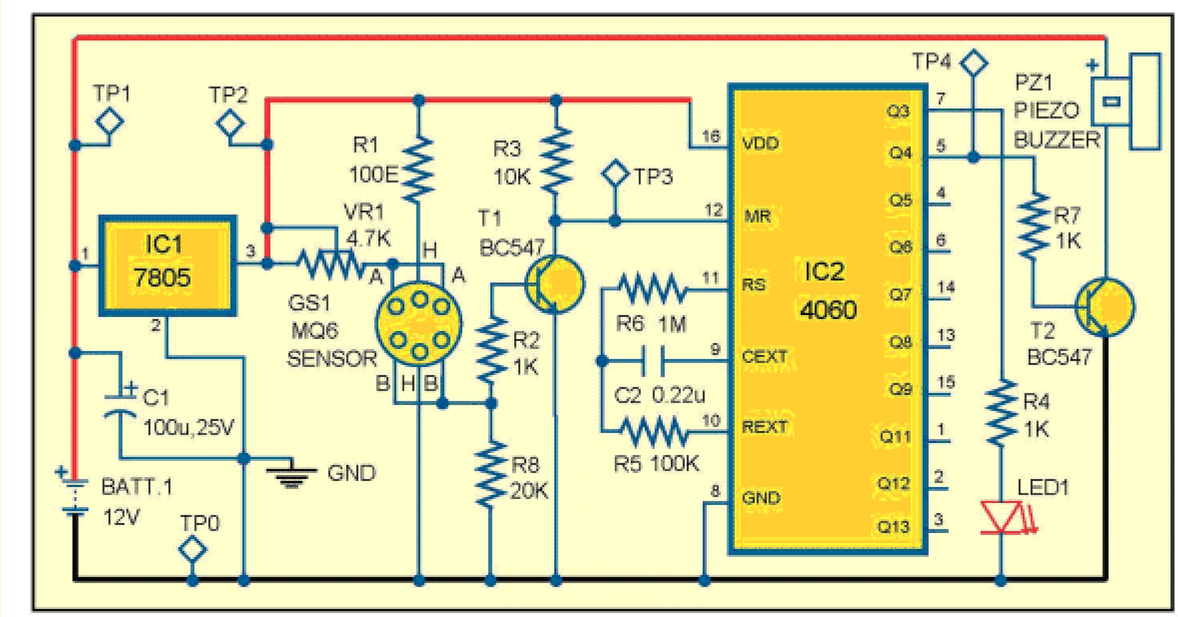
When the voltage falls below 1v, the chip is reset.
Even though NO CURRENT is required by the line, you MUST pull the line low via a resistor so that the gate sees a LOW VOLTAGE.
In the circuit above, the transistor pulls the gate HIGH to keep the chip activated, but when the LDR sees illumination, the voltage between the base and emitter is less than 0.6v and the transistor "turns off."
This makes the collector lead a HIGH IMPEDANCE LEAD and it is just like removing the transistor from the circuit.
This leaves the reset line "floating" and there is nothing pulling the line LOW. It requires 100k to 1M from pin 4 to 0v.
This is a major fault in the design of the circuit due to the author not knowing the internal features of the chip.
Electronics For You also failed to pick this up because they have no technical staff to diagnose and check a circuit.
This leaves the experimenter in the invidious position (likely to arouse or incur resentment or anger in others) of finding the circuit does not reset and thinking he has made a mistake.

Here's another fault from **Electronics For You** (April 2013 issue)**:**



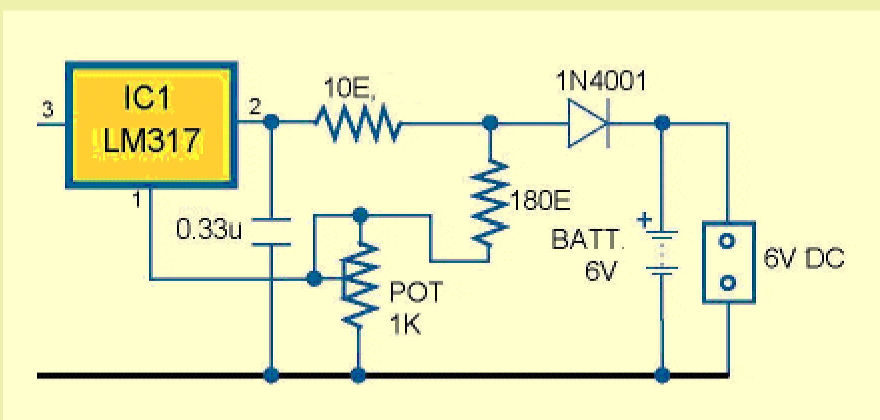
7-segment displays should have a current limiting resistor on each line (a,b,c,d,e,f,g) so that each number (0,1,2,3,4,5,6,7,8,9) will illuminate with the same brightness.
In the circuit above, the common line has a 680R resistor and when a single segment is illuminated, 4mA will flow through the segment. When two segments are illuminated, each segment will get 2mA. When all 7 segments are illuminated each will get 0.5mA. The display will get duller and duller.
Obviously the circuit has never been tested.
Each line should have a 220R resistor and the common line is connected directly to 5v.
This project has been designed by Sani Theo, the Technical Editor for the magazine.
You can now see why the magazine has so many faults.

Here's another untried, untested circuit from **Electronics For You** (April 2013 issue)**:**



The Gas Sensor is supposed to be connected DIRECTLY to 5v, not via 100 ohm resistor.
The Gas Sensor has a heater that draws 150mA @ 5v (750mW) and if a 100 ohm resistor is added, the heater will take 37mA. (the Gas sensor heater has a resistance of 33 ohms).
This circuit has never been tested and may or may-not work with 37mA heater current, but it will certainly take longer to make a reading because the idea of the heater is to burn the air-gas mixture and take a resistance reading from a ceramic substrate.
This circuit has been supplied by Professor Mohan Kumar and we have already identified him as being completely inept at designing electronics circuits.

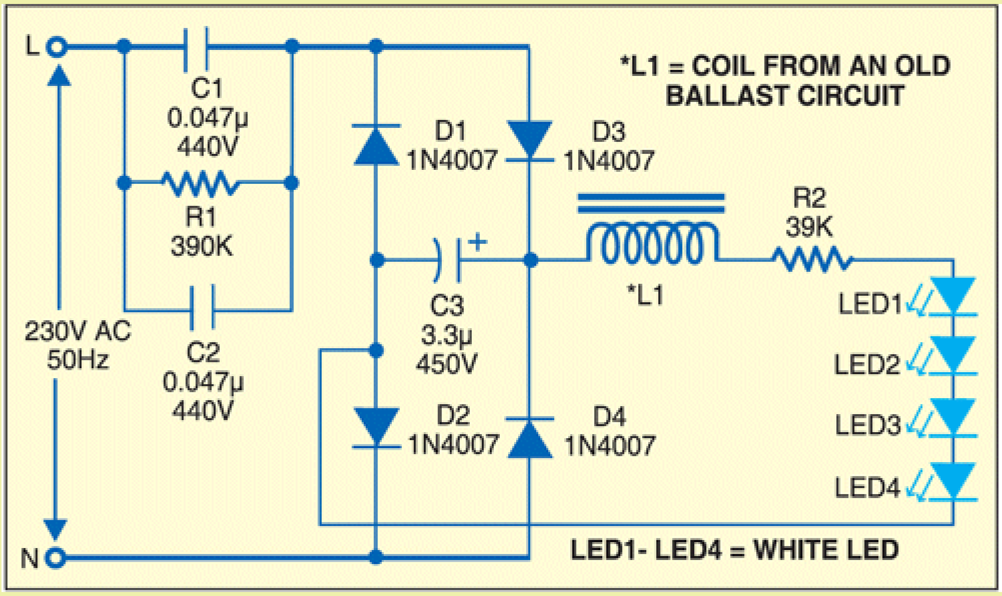
Here's another untried, untested circuit from **Electronics For You** (April 2013 issue)**:**



We start the discussion with just the LM317 3-terminal regulator.
It is designed to produce a voltage of 1.25v above the voltage on the adjust pin (pin 1) and it monitors this voltage accurately.
This means the output voltage will be 1.25v when the adj pin is connected to 0v.
If we add a 180R resistor and 1k pot, we can "jack-up" the output voltage until the output is about 2v less than the input. (This 2v is needed by the circuit inside the IC.) If this voltage is delivered to a load, the chip will deliver up to about 1.5amp.
Now we add the 10 ohm resistor.
This resistor is called the CURRENT LIMITING resistor and normally it is added as shown but the 180R and 1k pot is removed and the adj pin is connected between the 10R and diode.
For a 10R resistor, the maximum current is 125mA
When this is done, the output voltage will rise to any voltage (that is about 2v less than the input voltage) and as the voltage rises, the current through the load will increase and also through the 10R resistor, (because they are in series).
As the current through the 10R increases, the voltage across it increases and when it reaches 1.25v, the circuit inside the IC detects this and the output voltage stops increasing.
When we add the 180R and 1k pot, we have an unusual situation.

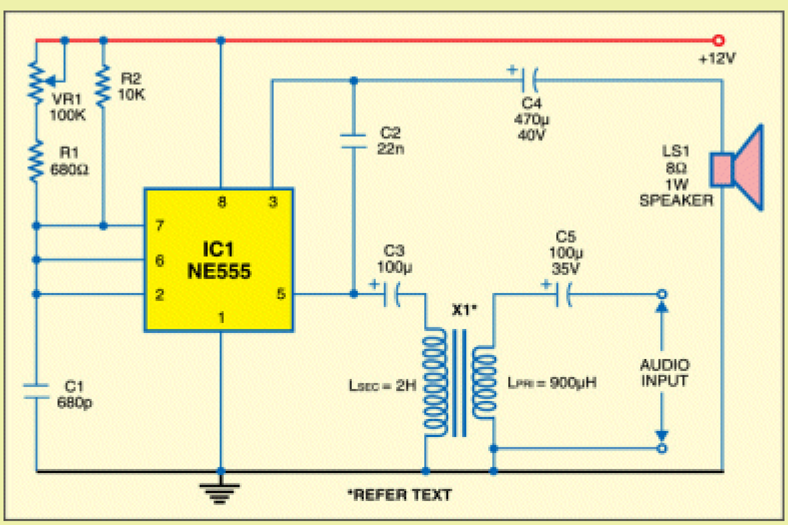
We can increase (jack-up) the voltage on the output to about 8v but when we add a load, the 180R alters the current limiting to 35mA.
If the circuit requires 35mA charging current, a 33R resistor can be used and the 180R and 1k pot can be removed.
You cannot add both features at the same time. If you try to set the output voltage, it will decrease rapidly as current is drawn.
Another untried, untested circuit from **Electronics For You.**

Here's another faulty circuit from **Electronics For You** website**:**



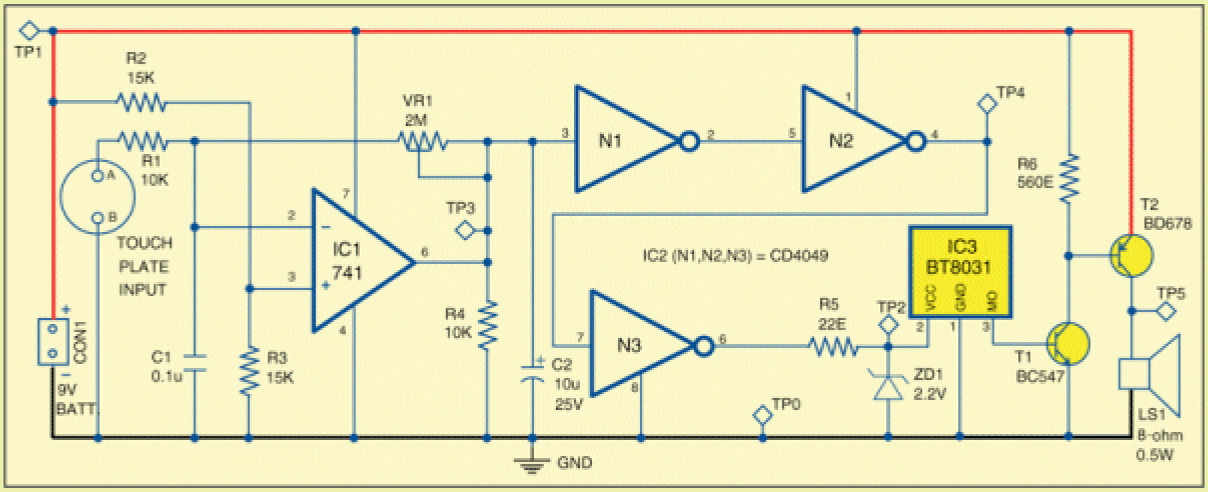
You have to work out the total impedance of the circuit.
This is 31k for the .047u + 0.47u (in parallel) and 39k for R2.
This means the current through the circuit will be 3.4mA
How bright will the LEDs be with 3.4mA !!!!

Here's another faulty circuit from **Electronics For You** website**:**



The output of a 555 can only deliver 200mA to a load and this means the impedance (resistance) of the load must be 60 ohms or more for 12v supply.
However we have another factor that must be taken into account. The chip can only dissipate 600mW.
This means the output must be derated to 50mA when the supply is 12v.
Neither of these factors have been taken into account with the circuit above.
If we take a frequency of 500Hz, the capacitive reactance of 470u is LESS THAN ONE OHM !
This makes the output less than 10 ohms !
Another untried, untested circuit from **Electronics For You.**

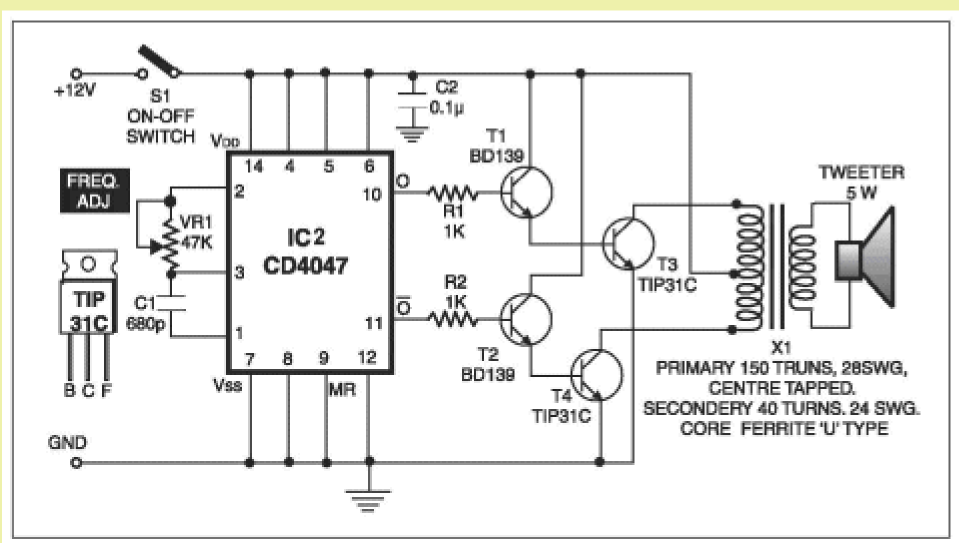
Here's another terrible circuit from **Electronics For You** website**.**
This circuit has been designed by Sani Theo - one of the Technical people at **Electronics For You.** He has absolutely no idea how to design a circuit:



This circuit has lots of mistakes. Apart from the fact that it does not work, here are the technical faults:

1. The output of the 741 sits at half-rail-voltage. This is a very bad voltage to deliver to a digital gate as it causes the gate to oscillator at high frequency. The output of the 741 should go to a very low voltage to provide a genuine LOW to the Inverter gate.
2. The output of pin 6 is low impedance. There is no point in placing a 10k on pin 6 to 0v rail.
3. C2 serves no function. Pin 6 is low impedance and the electrolytic has no effect.
4. Gates N2 and N3 have no effect on the circuit and can be removed.
5. R5 22R is far too low to protect the output of the Inverter gate.
6. IC3 needs a 1k on the output as shown in the specification sheet.
7. R6 is far too low for the position shown. It should be 4k7 to 10k.
8. T2 is a Darlington Transistor and should be shown as a Darlington.
9. There is no current limiting resistor between T1 and T2 and more than 100mA will flow though the base of T2 as wasted current.
10. There is no delay to allow the music IC to produce the Ding Dong sound.
That's 10 poor designs in a simple circuit from someone who touts himself as a **Technical Editor**. What a disaster.

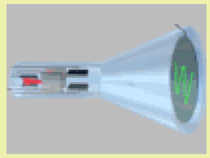
Here's faulty circuit from **Electronics For You** from the year 2000**:**



The transistors are directly connected to the power rail via collector-emitter and base-emitter junctions and when the transistors are turned ON, these junctions have a very low voltage across them. This means a very high current will flow.
The actual current will depend on the base current from a previous stage and the CD4047 can deliver 10mA. If the

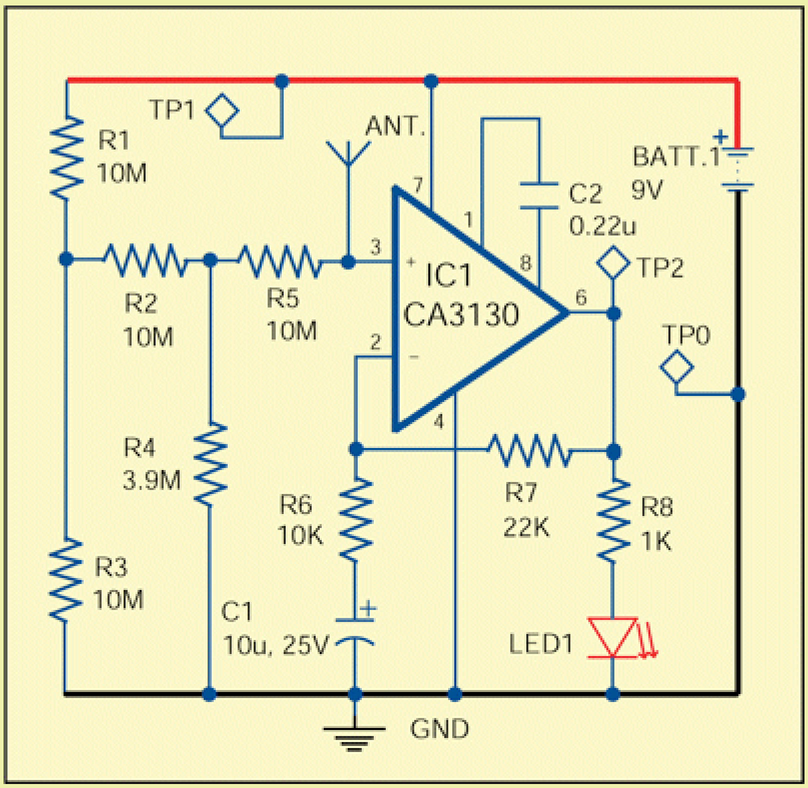
transistor has a gain of 100, this means a wasted current of 1AMP will flow through the transistors, and especially the base-emitter junction, which is not designed to pass this high current.

Here's a faulty animation from:
http://electronicsgurukulam.blogspot.com.au/2012/07/cathode-ray-tube-animation.html



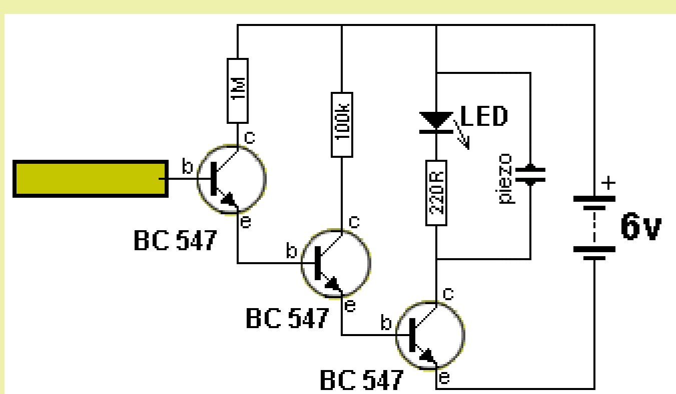
The animation is entirely wrong.
The beam is deflected in the neck and then it travels in a STRAIGHT LINE to the screen.

Here is over-designed circuit by D. Mohankumar:



It detects if a cable is carrying the "mains."

All you need is 3 transistors and you can add a piezo diaphragm to hear the "mains."

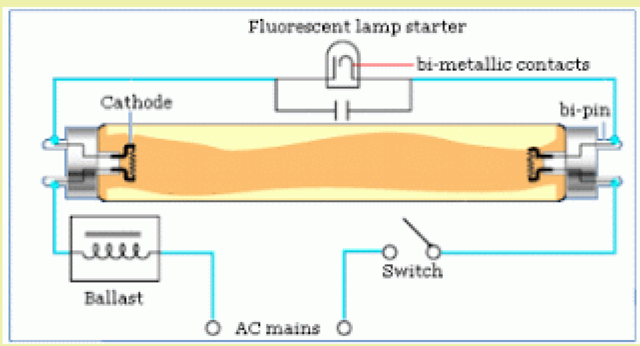


MAINS HUM DETECTOR

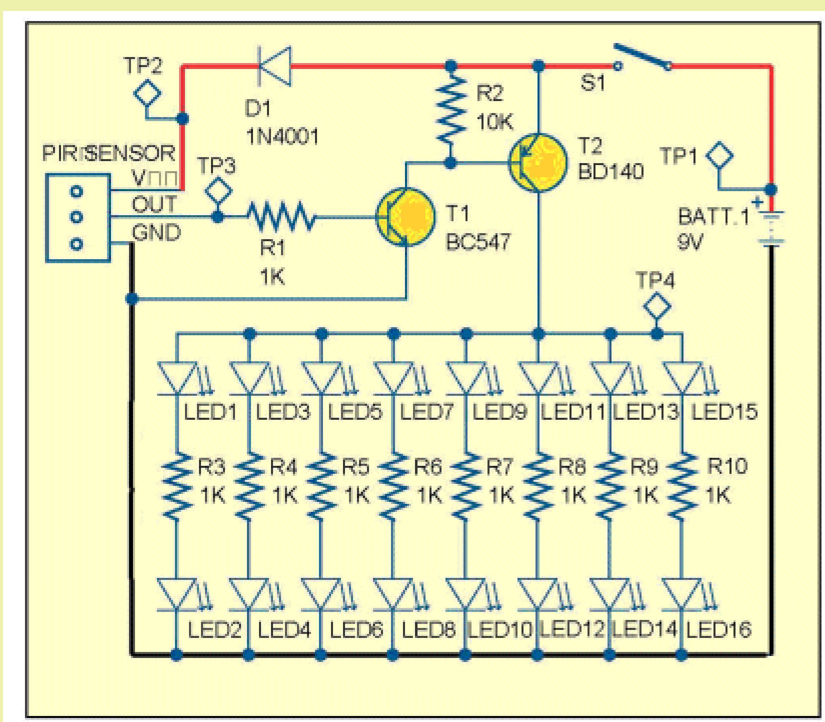
http://electronicsgurukulam.blogspot.com.au/2012/11/tubelight-starter-working.html

Here's the correct description of starting a fluorescent tube:

Fluorescent tubes are used in all types of lighting systems. It is filled with argon gas and a tiny amount of mercury vapour to reduce the starting voltage.
Argon gas of this length would normally take thousands of volts to "strike."
The tube is connected as shown in the diagram and when power is applied, the starter starts to glow.
Current will not pass through the tube because the gas inside it is not ionized and it behaves as a open circuit.
The starter contains a tube with neon gas and this gas needs about 70v to 90v for it to glow.
Also inside the starter is a bimetallic switch that is open. The glowing gas heats up the bimetal strip and it closes.
This allows current to flow through the ballast and the filaments at the ends of the fluorescent tube.
The filaments heat up the gas in the tube (at the ends) and the mercury vapour and the electrons are excited.
The gas in the starter ceases to glow (because the bimetal strip has closed) and the bimetal strip cools down and opens.
This allows the current in the ballast to collapse and it produces a higher voltage.
This voltage (together with the mains voltage) is sufficient to "strike" the tube and immediately the voltage across the tube drops to about 90v.
The ballast now takes up the difference between the supply voltage and the tube voltage.
If the tube were placed directly across the supply, it would take a very high current and blow up.
The voltage across the starter is now not enough to re-strike the neon gas and it remains "off."



Electronics For You and **T. K. Hareendran** will never learn.
Here is another JUNK circuit from the April 2103 issue of EFY.
I have emailed both on many occasions to send me any circuit before publication. They have failed to do this and prefer to show **how stupid they are**.

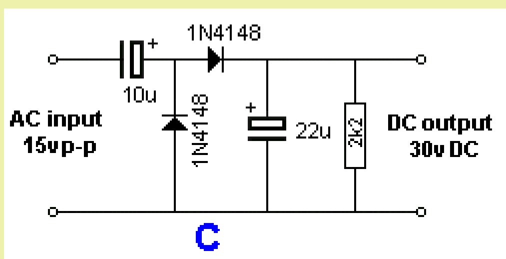


1. There is no current-limiting resistor between the two transistors. If the first transistor is turned on via 2mA into the base, the collector will pass 200mA or more.
2. Each string of LEDs has a characteristic voltage drop of 3.2v x 2 = 6.4v. The voltage across the 1k resistor will be less than 3v and 3mA will flow through each LED.
3. Why use a power transistor BD140 to pass 30mA !!

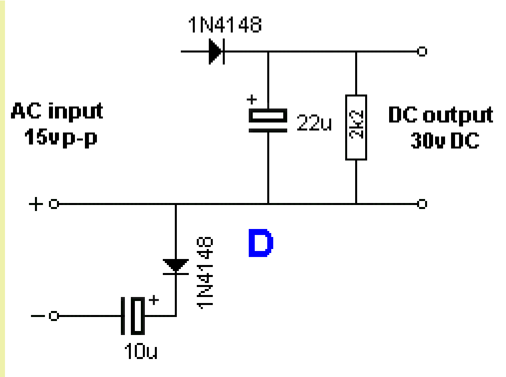
What a useless, badly designed circuit. The current through the transistors is more than through the LEDs.
Another useless, untried, JUNK circuit to mess-up Indian experimenters.
T. K. Hareendran has emailed me to say his prototype used 150R resistors and for some reason they were changed to the absurd value of 1k. That's **Electronics For You !!**
T. K. Hareendran has added the fact that the circuit takes 130mA through the transistors as wasted current.
The prototype was re-tested with a 1K5 resistor between base of T2 and collector of T1, and the efficiency improved considerably.
That's why you have to take a reading of the current taken by the circuit in all states and conditions, just in case something is faulty.

Here's a terrible explanation of how a **Diode Pump** works from **Professor D. Mohankumar**.
email: mohanwordpress@gmail.com
His circuit had the 10u around the wrong way. But his explanation is not only incorrect, but almost impossible to understand.
The 10u receives the AC signals and transfers the full AC wave form across it. But the midway level is still the same, therefore only the voltage above 0 volt passes through the top diode.
When the waveform from the 10u tries to go below 0 volt, the first diode takes the current from the negative rail. Therefore voltage never goes below 0 volt at the junction of the 10u and the diodes. When the waveform from the 10u rises, the rise is from minimum (0 volts) as imposed by the first diode. Since the waveform is not changing, the total voltage between the upper and lower peak of wave is then pumped into the top diode and then into the 22u.
No wonder Indian students don't understand electronics - **I** cannot understand what he is trying to say.

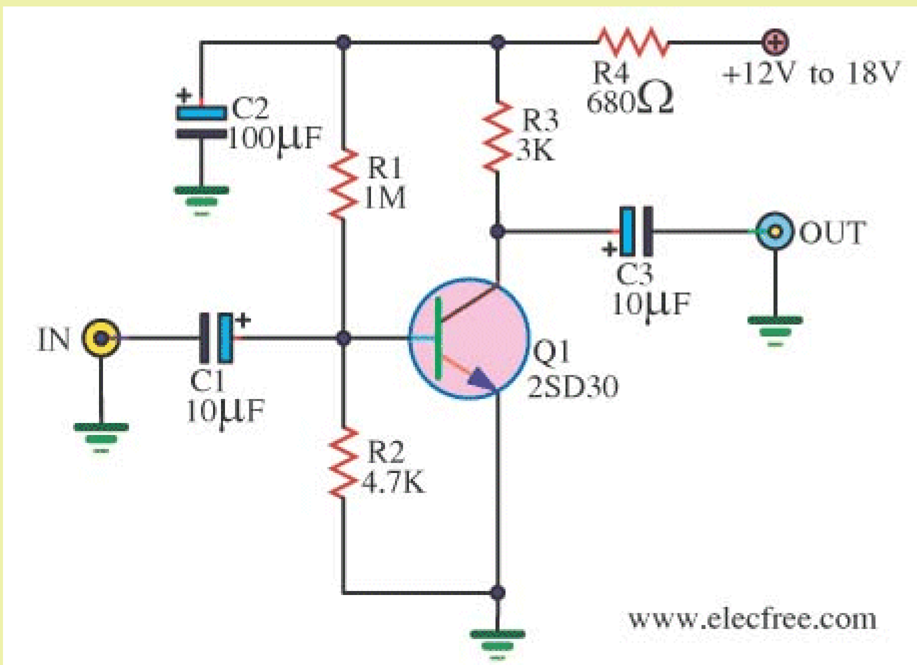
Here is a clear description of how the circuit works:
Circuit C is a **DIODE PUMP** (**VOLTAGE DOUBLER**) from an AC source (such as the "Mains").

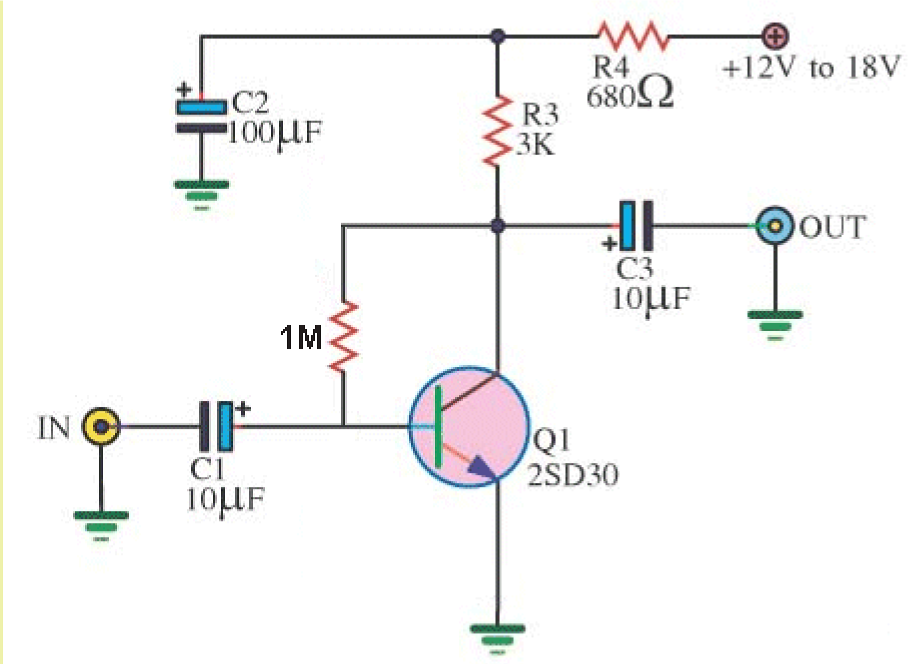


The circuit takes a number of cycles to get up to full output voltage and this is how it works:
The best way to consider an AC waveform is this: The bottom rail is 0v (or neutral) and the voltage on the top rail rises from 0v to 15v (in this case). The voltage then decreases to 0v and then the top rail jumps to below the bottom rail and it increases in the negative direction until reaching -15v. It then decreases until both rails are 0v and then it goes above the negative rail and increases to +15v.
We start with the input voltage rising and because the 22u is uncharged, the 10u starts to charge as soon as the 0.6v across the top diode is reached.
The 10u charges to about 10v and puts about 5v on the 22u - this is how the 15v is divided-up on the first cycle.
When the AC reverses polarity, the top diode does not have any effect but the lower diode becomes forward biased and it allows the 10u to charge to about 15v.
When the AC reverses again (so that the top input becomes positive), the 10u has 15v on it and incoming the AC voltage adds another 15v.
This means the positive lead of the 10u is 30v above the lower rail and it charges the 22u to about 15v - this is how the voltage is divided between the two electros in the second cycle.
This happens a few more times and eventually the 22u gets charged to 30v (minus 2 x 0.6v diode drops).
After 5 or more cycles, the 22u has about 30v across it and the 10u keeps "topping up" the voltage as follows:
Say the 10u has 14v across it, when the top input of the AC becomes negative, the 10u immediately goes to a position below the 0v rail and the diode connected to the 10u allows it to be charged to 15v, (the top diode effectively comes "out-of-circuit" as shown in diagram D. The circuit only receives a "charging-pulse" during the time when the top rail of the AC voltage is NEGATIVE. It delivers this energy to the circuit when the top rail of the AC is POSITIVE.

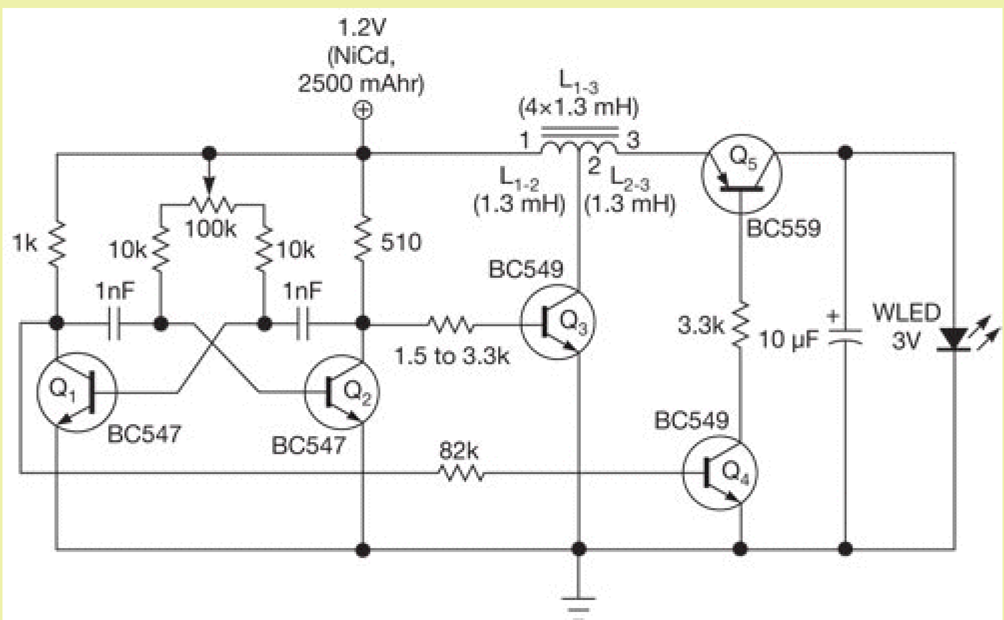


This PRE-AMPLIFIER circuit will not turn ON because the voltage on the base is 50mV and it should be 650mV.
The voltage-divider resistors on the base are incorrect. The 4k7 should be at least 47k.
Using the correct ratio of base resistors will turn the transistor ON but the actual voltage on the collector will depend on the gain of the transistor. Using 3 resistors in a semi-bridge arrangement is not a good idea. It should have an emitter resistor bypassed with a 100u electrolytic.
It is much better to use a self-biasing stage as shown in the second diagram to produce approx mid-rail voltage on the collector.





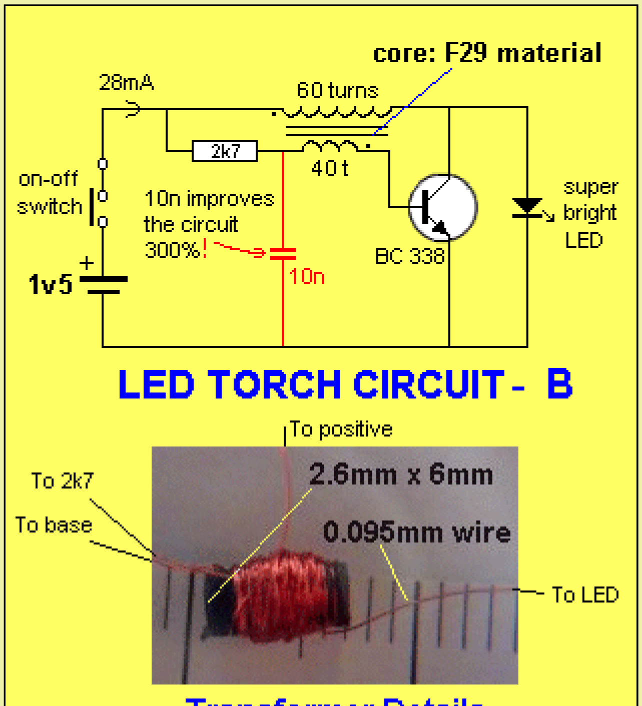
WHITE LED DRIVER



I have never seen a more-ridiculous circuit in all my life. Apart from being over-designed, it contains a number of technical faults.
A BC549 will not pass more than 100mA at the best of times and in this circuit the base has a 2k resistor so the current is limited to less than 100mA. It is not a "power transistor" and has no current-carrying capability. Maybe a BC338 with 1amp capability is a better choice.
The charging-current through the inductor is an indication of the energy that will be available when the transistor is turned off and in this circuit the charging-time can be adjusted.
You only need to allow current to flow through the inductor until it is saturated. Any further current-flow is wasted. It is impossible to determine this without accurately measuring the flux produced by a totally isolated secondary winding. And this feature is not available in this circuit.
See our Joule Thief article for correctly-designed driver circuits.
What is the point of transistors Q4 and Q5? They serve NO PURPOSE. They simply turn ON and allow energy to flow to the 10u and LED. You cannot pass all the energy from the inductor by simply adjusting the mark-space ratio when you are using the same adjustment for the "charging operation." It just needs a high-speed diode to pass the energy.
The inductor is overly complex. If you turn off the transistor quickly, the back emf (high voltage) produced will be sufficient to drive a white LED. You don't need and extra winding.

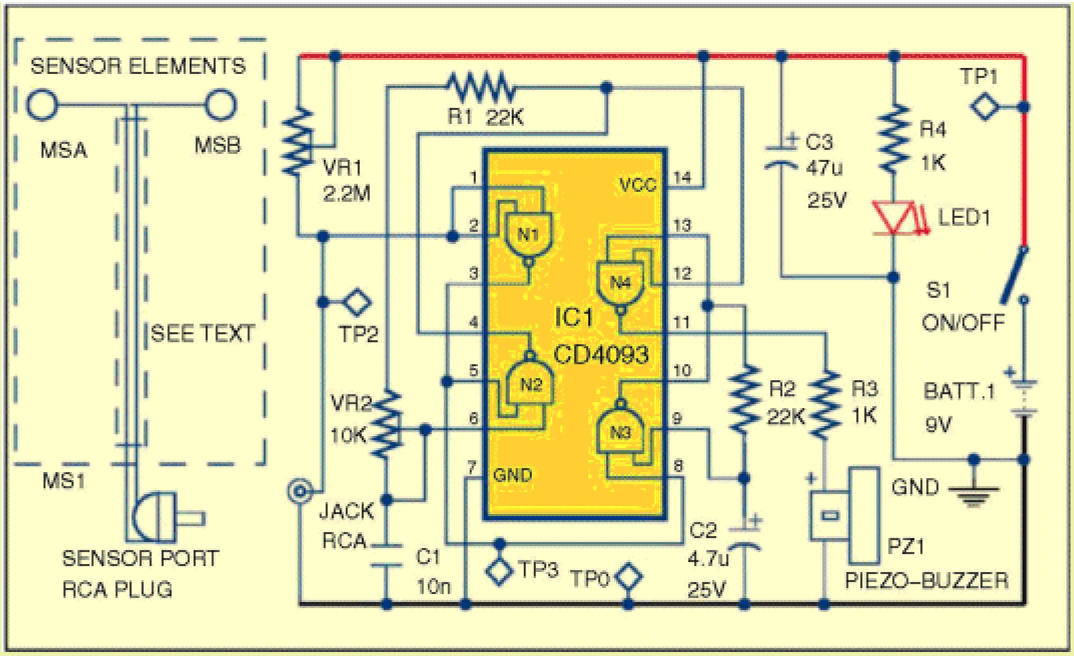
The 510 ohm resistor on the collector of one of the multivibrator transistors means current is being wasted for part of the cycle.
The driver transistor should be "driven" by a previous stage and not simply "pulled high." What the designer has done is analogous to turning off a car's headlight by shorting across the battery.
The characteristic voltage-drop across a white LED is between 3.3v and 3.6v. He suggests 3v and it indicates he has not driven the LED to its capability. He has used a 1 watt LED and delivered 30mA.
The 10u across the LED has very little effect as it gets charged to 3.6v and when the voltage drops to 2.8v, the LED is not illuminated. This small amount of energy from a 10u will hardly be noticed.
The designer claims the output of the multivibrator is triangular, whereas a multivibrator is known as producing square waves.
The circuit below turns ON the transistor HARD to produce the highest output. The circuit above turns on the transistor very feebly and it will have a high collector-emitter voltage that represents wasted energy.
There is no point in having a tapped inductor. By driving the transistor correctly, a single inductor will produce sufficient voltage to drive the LED. The inductor used in the circuit is expensive ($5.00) and a simple hand-wound coil could be used.
Overall a badly-designed circuit that is overly complex and very inefficient. A good study in "how **NOT** to design a circuit."

When you see a simple single transistor circuit that performs the same function, you realise how stupid to try and guess the timing to "charge" the inductor. The following circuit does it automatically and by simply changing the number of turns on the transformer (and its size), you can increase the output. See the Joule Thief article for more details and a circuit using a transformer with an AIR CORE !



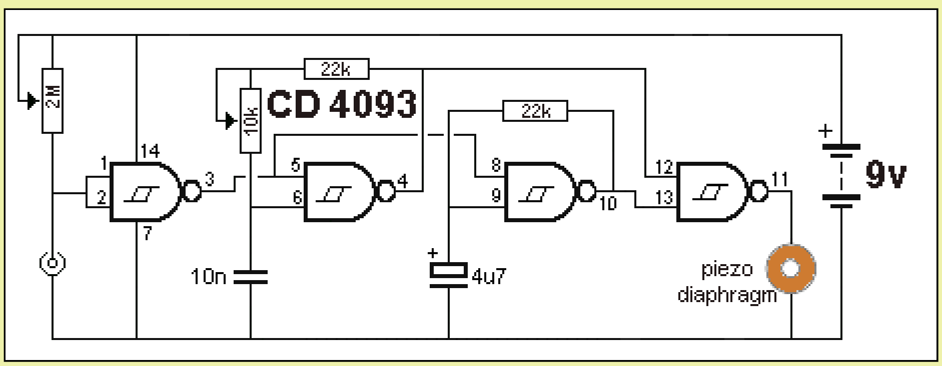
Transformer Details

WET NAPPY ALARM



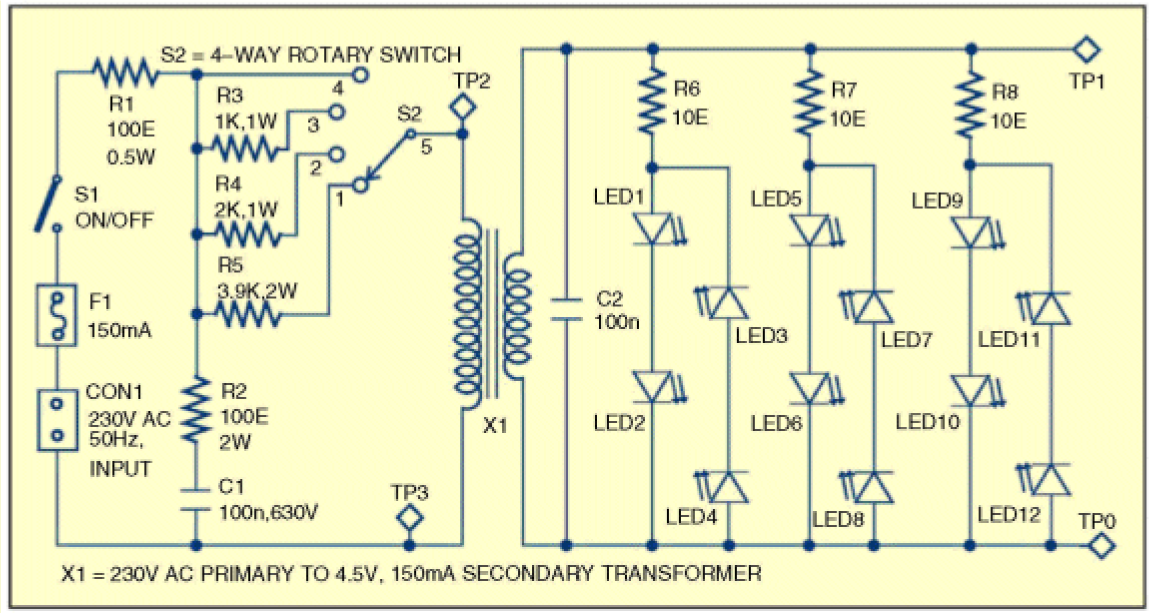
The main reason we included this circuit is due to the layout.
It is impossible to work out what the circuit is doing. The layout is just a jumble. The circuit is presented in the May issue of **Electronics For You** Magazine and is supposed to cater for beginners to show how a circuit works. **I have no idea what the circuit is doing**. How do you expect a beginner to learn from this layout ????

Here is the correct way to layout a circuit so the operation of each "building block" can be understood:



Each NAND gate is a 2-input Schmitt Trigger with the first gate wired as an inverter. The second Schmitt inverter is a high-frequency oscillator and the third gate is a low-frequency oscillator. These two oscillators are gated to the fourth block to drive a piezo diaphragm as beep-beep-beep.
A 1k on the output is not needed and will only reduce the loudness of the piezo.

LED LAMP

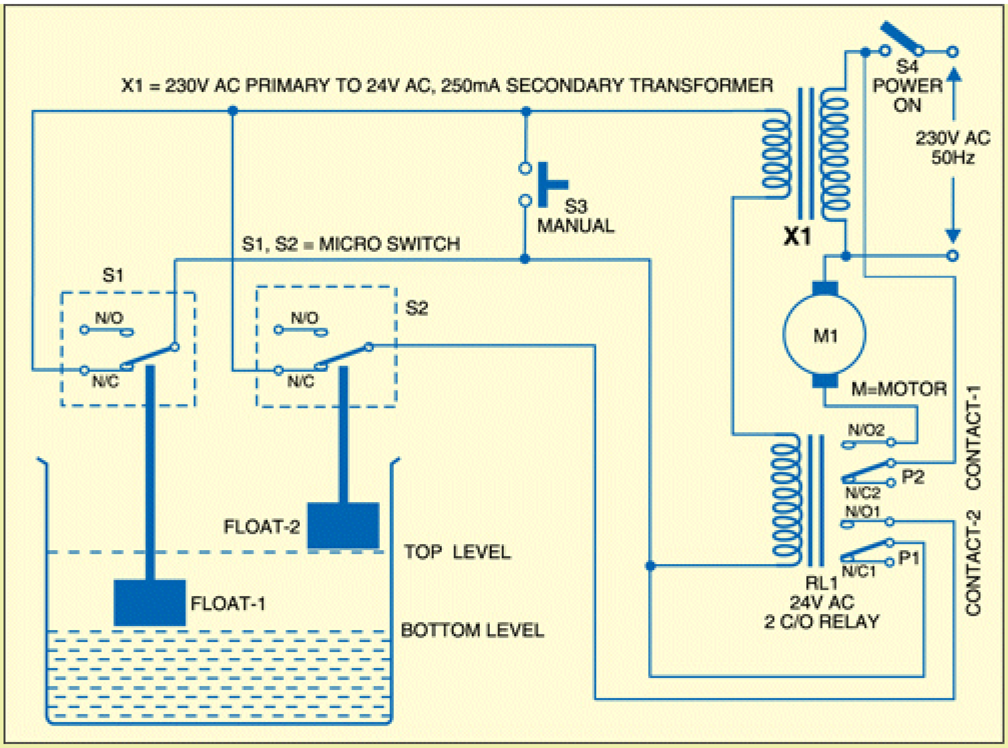


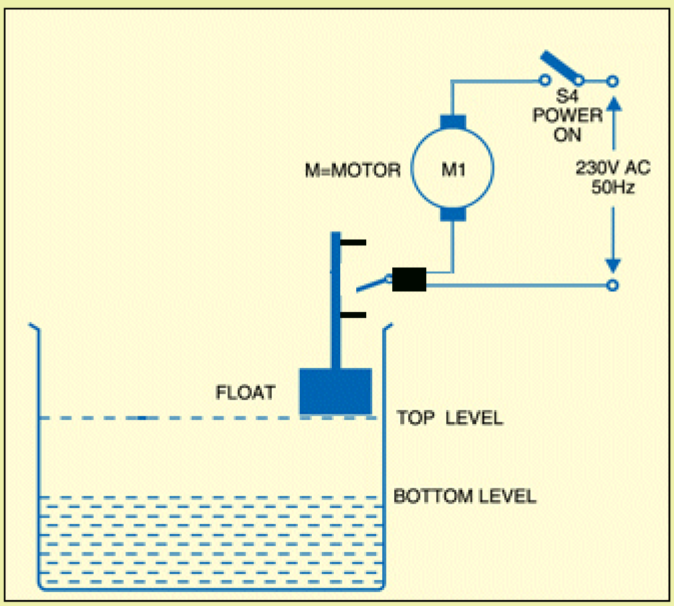
Here we have the ridiculous situation of providing isolation via a transformer but producing the dimming feature via a rotary switch on the MAINS SIDE of the transformer.
The same switch could be placed on the secondary side with smaller wattage resistors to produce a much-saver circuit.
The purpose of the two 100 ohm resistors, 100n capacitor and 150mA fuse is unknown. [150mA fuses are very unreliable and when they are a slo-blo type, they do not burn out until 500mA flows.]
These items are not needed. The power lost in R2 is less than 5mW - why use a 2 watt resistor ????
The 10 ohms resistors are far too small to have any effect. We have already discussed using a low-value dropper resistor in series with LEDs in our 30 LED Projects eBook.
The whole circuit is badly designed and gives the wrong information to newcomers to electronics.
Sani Theo, the technical editor, doesn't know what he is doing and is just making a fool of himself and **Electronics For You** Magazine.
This is another stupid design from **Electronics For You** Magazine May 2013 issue.

When you are designing a circuit, you need to "THINK OUTSIDE THE BOX." This involves looking at the circuit and seeing if it can be improved. The circuit above is a typical example. It would not be accepted in Australia, where the rules for transformerless power supplies, switching the mains via rotary switches and, in fact, anything to do with power supplies, dimmers, battery chargers etc is tightly regulated and prevented from publication in hobbyist magazines.
The rotary switch should be placed on the secondary side of the transformer where it will be perfectly safe to handle and the circuitry will be simpler.

WATER TANK PUMP

Here's another absurdly over-designed circuit:

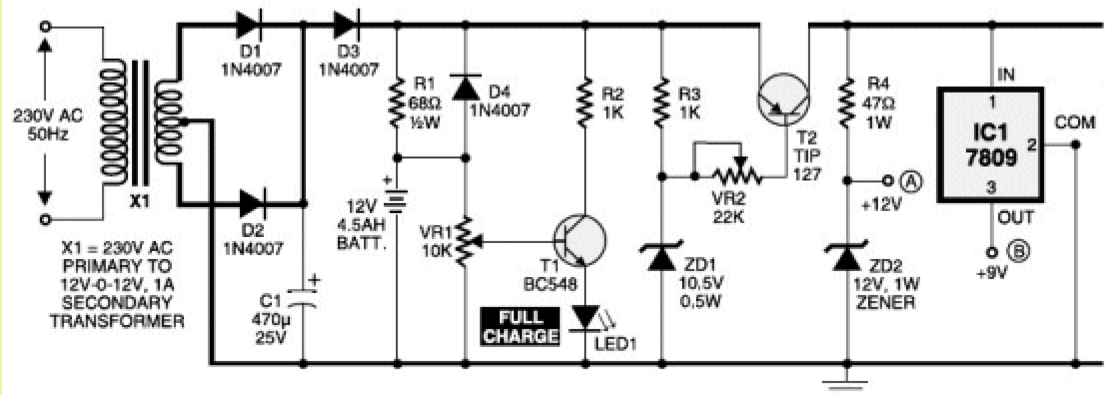




All that is needed is a float with a pin at the top and bottom that moves the lever of a toggle switch. When the float falls it turns the pump ON and when it rises, the pump is turned OFF. The float can be a plastic Coca Cola bottle partly filled with water. A plastic pipe in the top and two pins to touch the switch. The pipe will need guides to all it to rise and fall.

This is another over-design from **Electronics For You** Magazine where they didn't "THINK OUTSIDE THE BOX."

MINI UPS

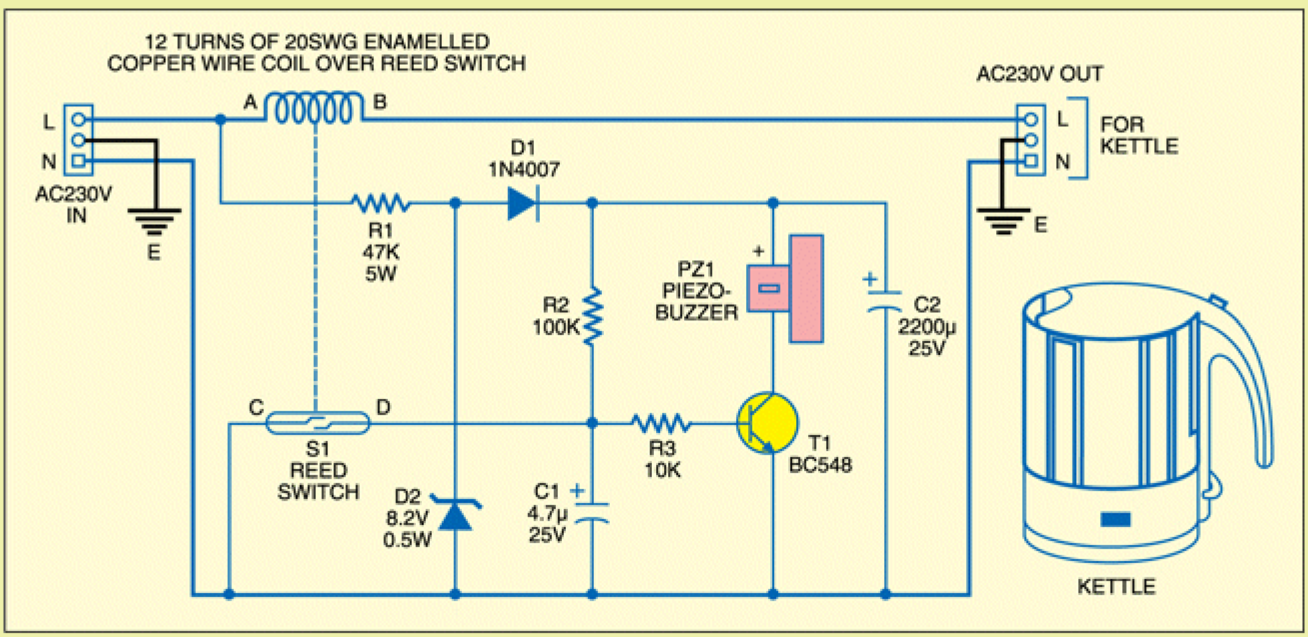


The 12v battery will drop 0.6v across D4 and a further 2v across the emitter-collector of the Darlington transistor T2.
The output at "A" will be less than 9.4v and not 12v.
The 9v regulator will also drop out of regulation as it needs at least 2.5v across the IC.
This circuit is a failure as a back-up power supply.
What is the purpose of D3 ??? It is not needed.
The **FULL CHARGE** LED will come on slowly and not give an indication of the exact point when the battery is charged.
What is the point of ZD1, the 22k? (20k) pot and T2 when the output has a regulator and 12v zener.
The whole circuit does not make any sense.

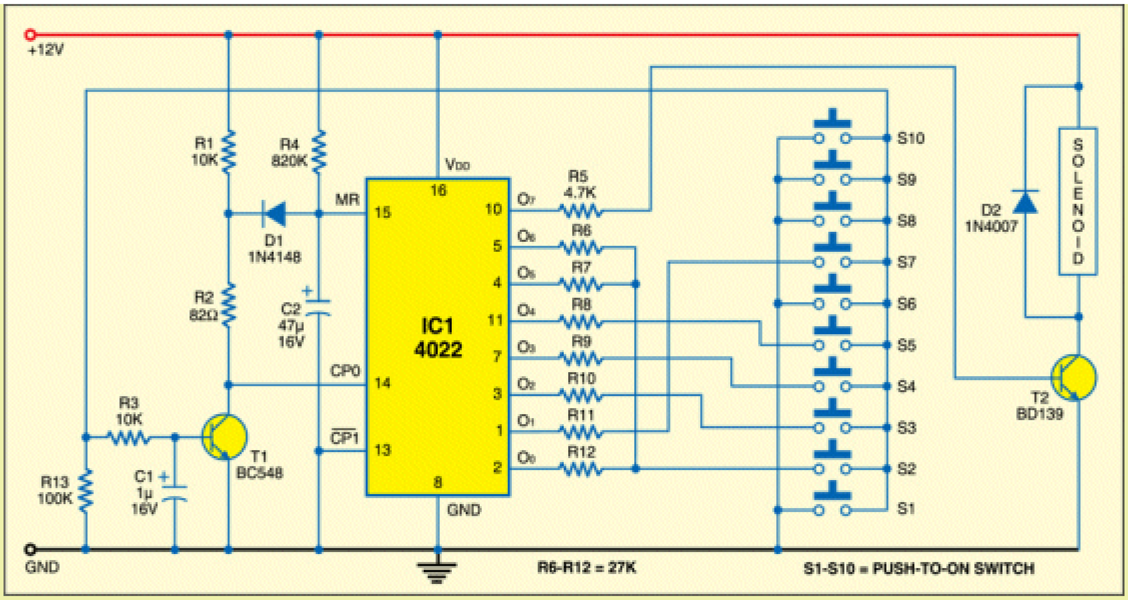
More Junk circuits from **Electronics For You** website:

This circuit detects when the kettle turns off. But the 47k will only provide about 2-3mA for the piezo buzzer and they require 10mA to 20mA.
The reed switch will be vibrating at 50Hz during the 5 minutes when the water is heating and this will eventually break the reed. They do not last very long. Each heating will create 15,000 vibrations.
Why have 2,200u to collect 3mA !!!

Just another JUNK circuit that has not been tested.

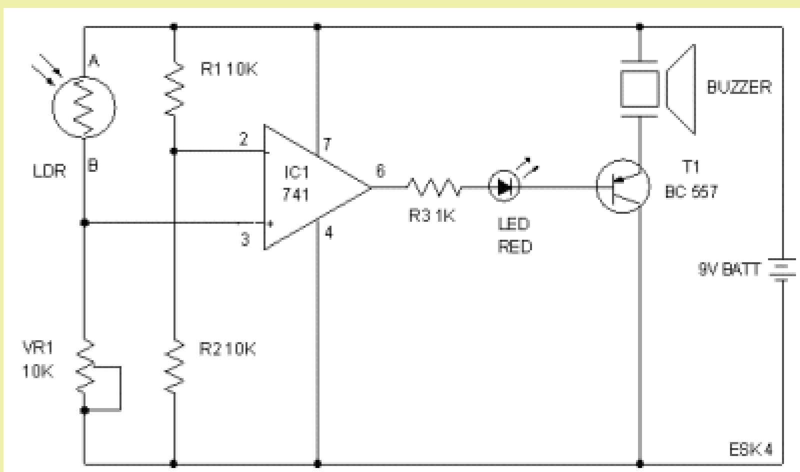


This is a STUPID CIRCUIT:



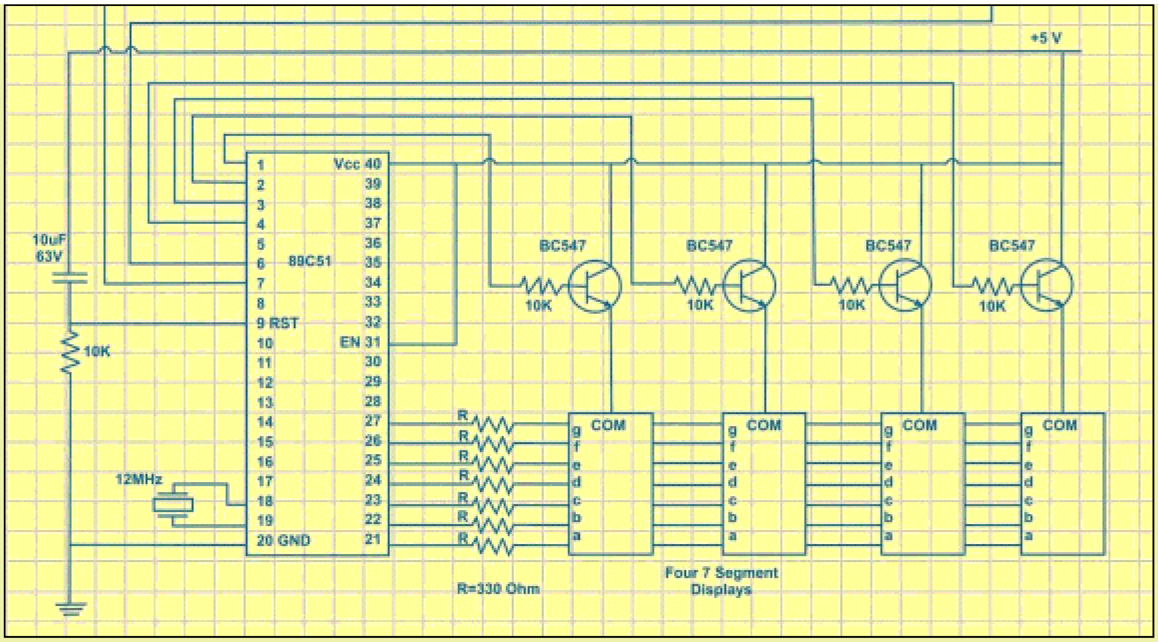
If you push the wrong button you are not penalised. Simply push each button (in turn) 7 times and the lock will open.

ALARM



Here's another circuit from **Professor D. Mohankumar** email: mohanwordpress@gmail.com that does not work.
The output of the op-amp goes LOW to turn on the buzzer. But the LED is around the wrong way and the transistor is an emitter-follower so that the buzzer will get less than 6v due to the voltage-drop across the LED, the base-emitter junction of the transistor, the drop across the 1k and the output of the 741 being slightly above the 0v rail.
He does not test ANYTHING !!!!!

MULTIPLEXING



Here we have a typical multiplexing arrangement where a microcontroller drives a 4-digit display.
Each display is accessed turn and it only gets turned on for 25% of the time. However you eyes have a feature called Persistence Of Vision (POV) that retains a previous image for a fraction of a second after it has been removed, so that the whole display will appear to be illuminated.
However to get a good brightness from the 4 displays, you have to drive them at 10mA to 15mA. The chip is only capable of delivering 10mA per output and it is really not suited to directly driving a display like this.
But when dropper resistors are included the drive-current decreases to a point where the display is almost useless.
That's the case in this example. The LEDs drop 1.7v, the sourcing transistor drops 0.6v across the base-emitter junction and the micro has 0.3v between output and 0v rail. This means the dropper resistors have 2.4v across them.
The 10k base resistor can be divided by 100 (the gain of the transistor) and included as a 100 ohm resistor. This means the dropper resistors equal 430 ohms.
The maximum current that 2.4v can deliver via 430 ohms is 5mA. The displays will be very dull.
The emitter-follower used to drive each display should not have a resistor on the base. This transistor should be turned ON-FULLY so the 330 ohm resistors can provide the current limiting.
A very poor design with a number of faults.

FRIDGE ALARM

This circuit comes from Future Kit, a Thailand based kit company. The component values do not matter as you can see the fault in the circuit by following this explanation:

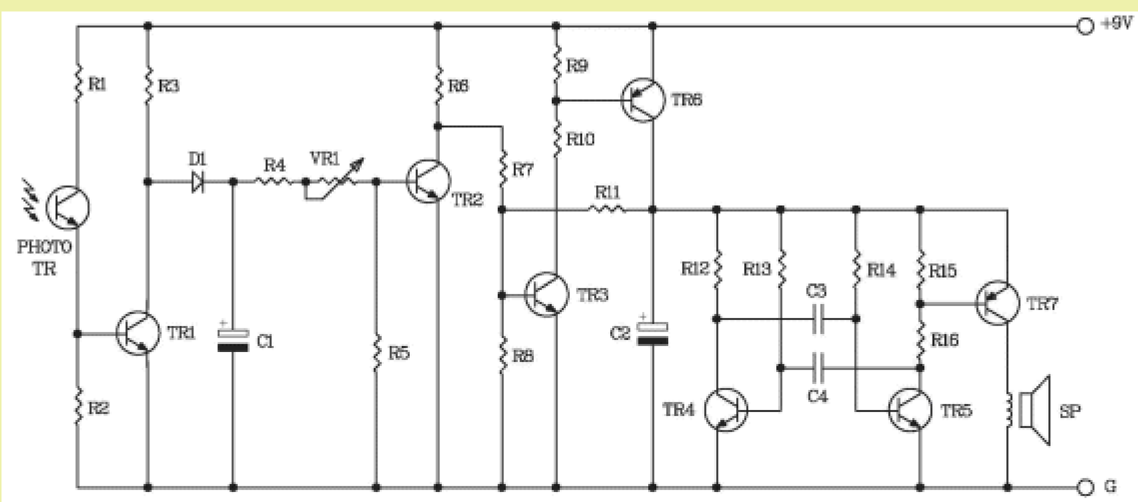
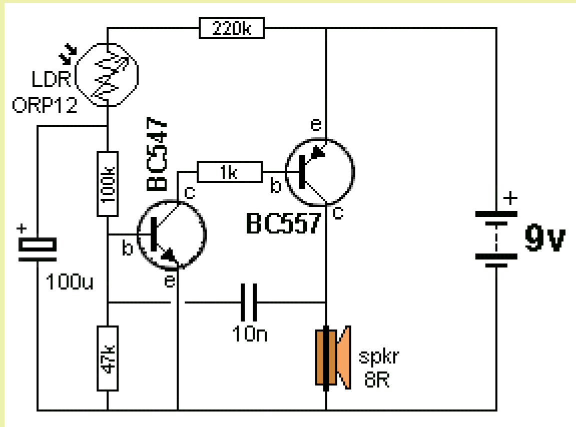


Figure 2. Refrigerator closing warning circuit

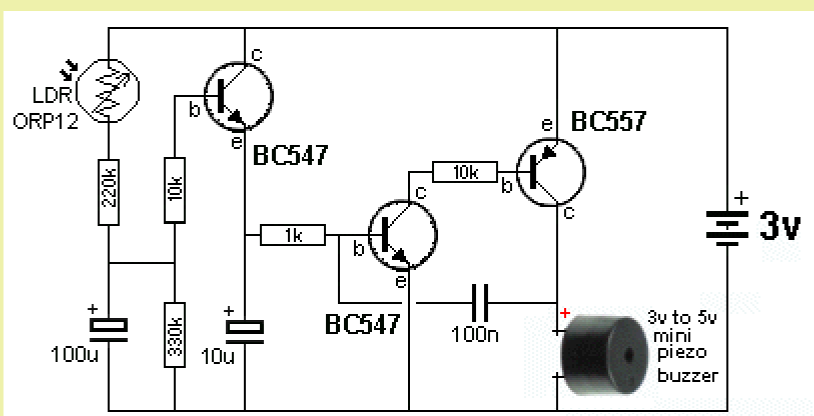
When no light falls on the photo transistor, it resistance is very high, the voltage on the base of TR1 is less than 0.6v and the transistor is turned OFF.

Capacitor C1 is charged via R3 and D1. This puts a voltage on the base of TR2 and the transistor is turned ON.
Full rail voltage appears across R6 and thus the voltage on the base of TR3 is less than 0.6v and the transistor is not turned on.
All the rest of the circuit is not active.
But a small current flows through R3, D1, R4, VR1, R5 and R6. This is an absurd way to turn off a circuit.
It's a bit like putting a short-circuit across a battery to turn of a globe or motor.
The circuit is effectively putting a short-circuit across the input of the switching transistor TR3 to keep the circuit OFF.
Here is a simpler circuit that takes NO CURRENT when the LDR does not detect illumination:



FRIDGE ALARM MkII

This circuit drives an active piezo buzzer and the circuit takes **no current** when "sitting around."
It will start to produce a sound about 15 seconds after the Light Dependent Resistor detects light.
The mini piezo buzzer contains a transistor and inductor to produce a high amplitude oscillator to drive the diaphragm and produce a loud squeal from a supply of 3v to 5v. It will not "turn on" from a slowly rising voltage so the circuit must be designed to rise rapidly when light is detected. That's the purpose of the 2nd and 3rd transistors. They form a high-gain amplifier that rises quickly due to the positive feedback provided by the 100n.
As soon as the second transistor starts to turn on, it turns on the 3rd transistor and the collector voltage rises. The right-plate of the 100n rises and since the 100n is uncharged, the left plate (lead) rises and increases the voltage and also the current into the base of the second transistor. This makes it turn on more and the action continues very quickly until both transistors are fully turned on. They stay turned on by the voltage (and current) provided by the first transistor.
Even though we normally see the second two transistors used as an oscillator, we can use the "rapid turn-on" feature to "kick-start" the piezo and if the middle transistor is provided with too-much voltage (current) on the base, the oscillator feature will not occur because the current into the base is too high and the 100n cannot remove this current during the turn-off period of the cycle. The only unusual feature of this circuit is the oscillator section starts to oscillate at very low amplitude when the first transistor turns off (when the LDR ceases to be illuminated) and a 10u has been added to stop this oscillation so it takes no current when at rest.



Electronics For You is still publishing circuits that do not work:

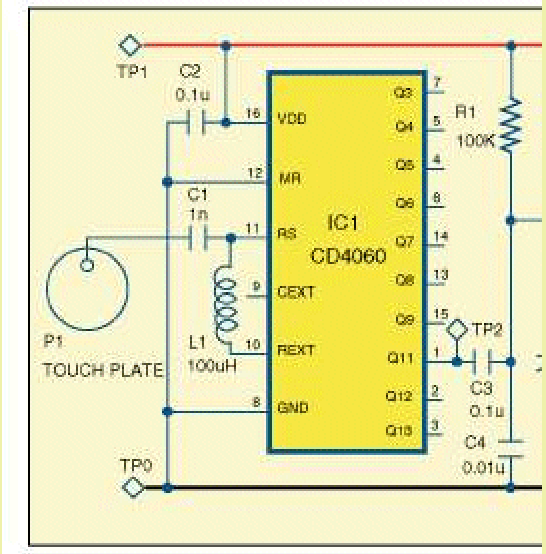


Fig. 1: Circuit of the touch alarm

An inverter is contained inside the chip, between pins 11 and 10 with the input on pin11. When an inductor is placed between these two pins, an oscillation is produced and the frequency is determined by the delaying action of the inductor. But the inductor has a lot of "strength" in delivering this signal, (because the inductor has a very small resistance) so that if a finger is placed on pin 11, the amplitude of the signal is not decreased.
For a TOUCH PLATE to work, the signal must be very weak and only just able to be detected by the input of a chip. When a finger is placed on the plate, the signal is absorbed slightly by your body and the input registers "no signal."
This circuit has been tested and DID NOT WORK. Another **Electronics For You** failure.
Try 10k to 100k in series with the 100uH inductor. (You need to make the oscillator-pulses very weak so your finger will reduce the amplitude.)

Another **Electronics For You** circuit that does not work:

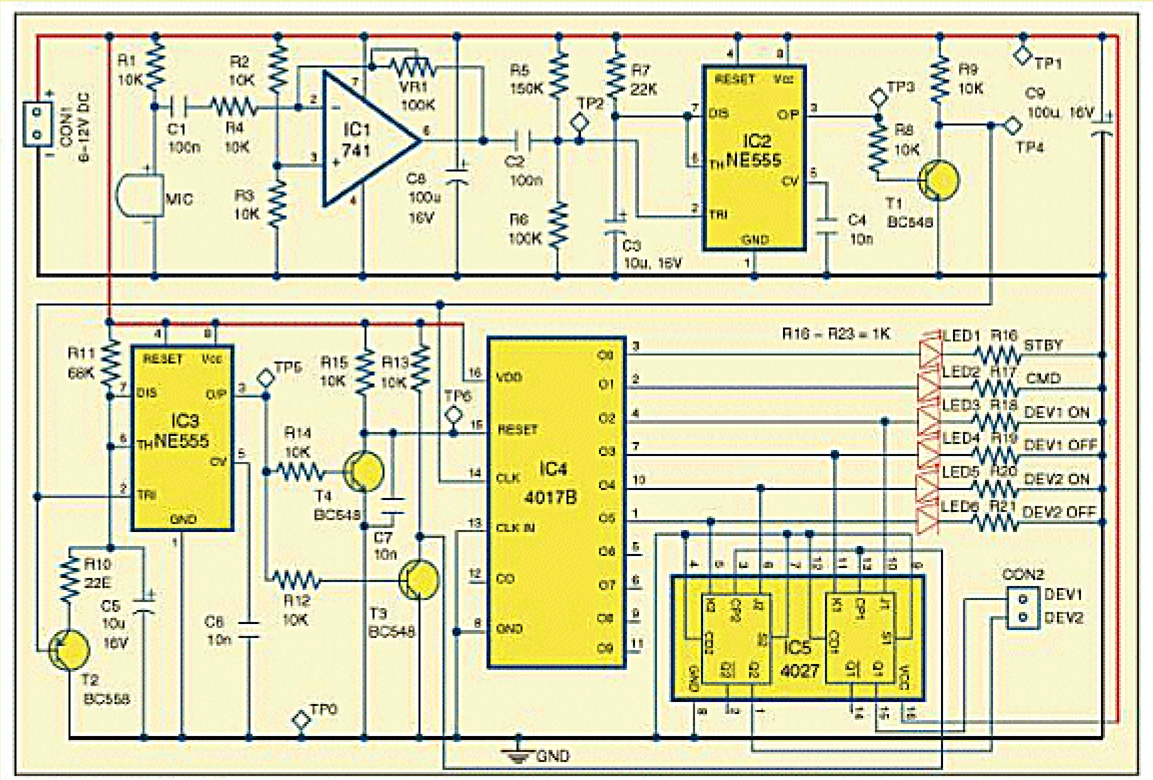


Fig. 1: Circuit of clap switch

Apart from the circuit being far too complex, the circuit contains a major fault.

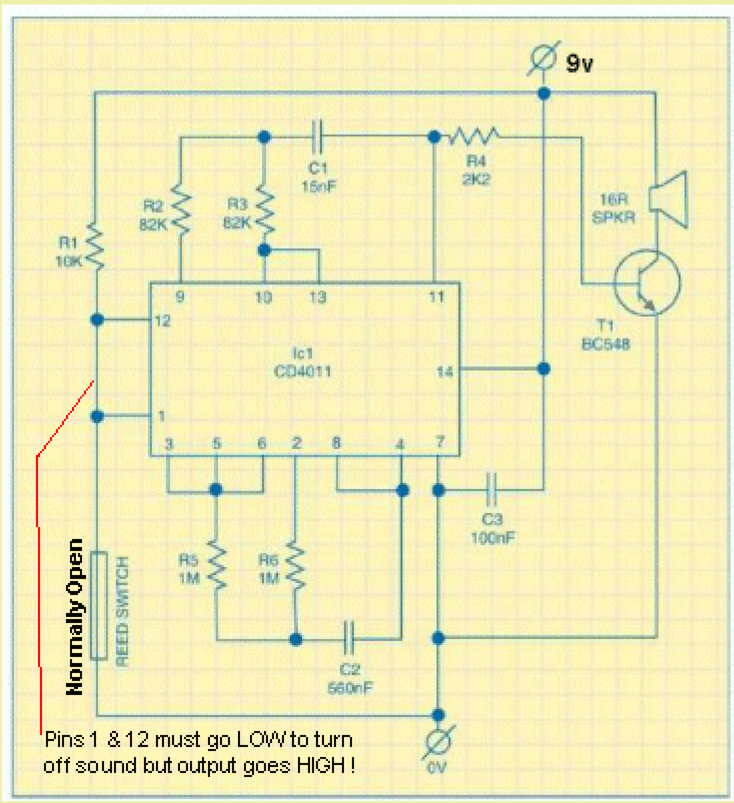
Here is the response to your claps:

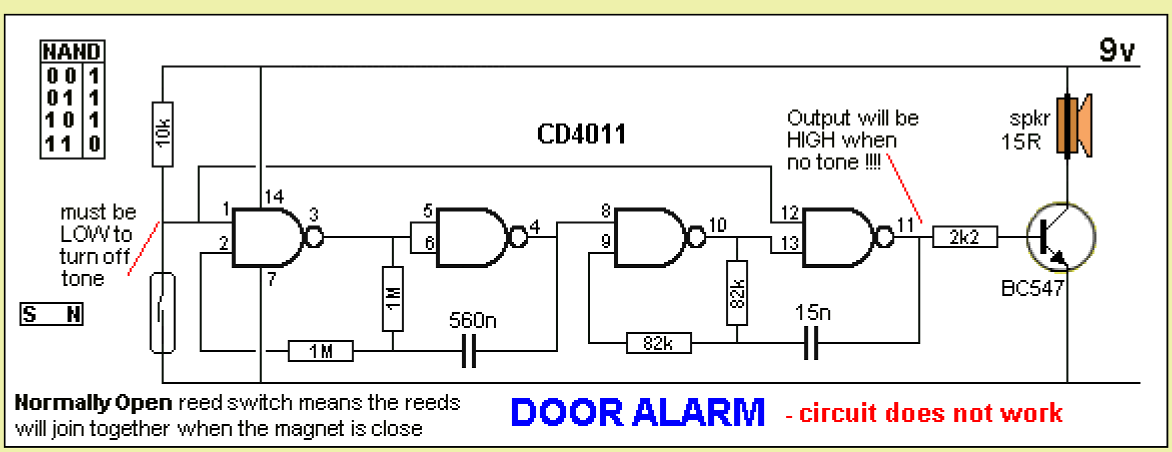
Two claps: Turn Device 1 'on'
Three claps: Turn Device 1 'off
Four claps: Turn Device 2 'on'
Five claps: Turn Device 2 'off

The designer of the circuit failed to mention the fact that you cannot keep device 1 ON and turn ON device 2, because the output sequence of the 4017 controls the flip flops in the 4027 IC and as the pulses pass the flip-flop that controls device 1, the flip-flop is RESET (as the signal passes to the flip-flop that controls the second device).
On top of this, you need a lot of claps to perform a simple task.
A really messy design that DOES NOT WORK !!!
You can see a simple design using a microcontroller on our new website: **Electronics Maker**

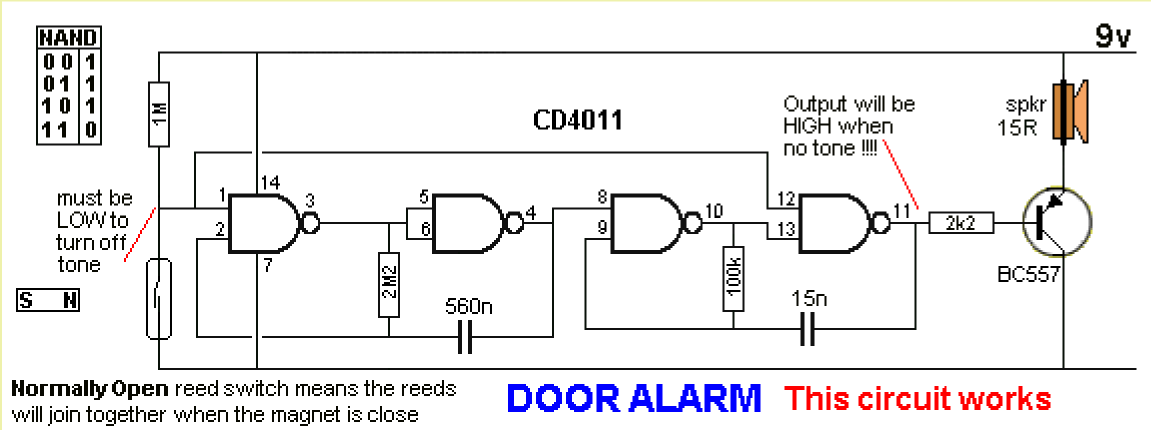
DOOR ALARM

Here's a Door Alarm circuit that does not work.
The circuit takes 1mA when sitting around due to the 10k resistor feeding the reed switch and the output of the circuit (pin 11) goes HIGH when the alarm is not producing a tone and this turns on the transistor and causes a high current to flow in the speaker. The battery will go flat in an hour.
It is impossible to work out the state of the gates when a block diagram is presented and all circuits should be drawn with gates, so you can see what is happening. The next circuit is drawn with gates, so you see the mistakes.





By making a few changes, as shown in the circuit below, it consumes less than 10 microamps when "sitting around." Two resistors have been removed as they are not needed. The 10k has been replaced by 1M and the BC547 has been replaced by BC557.



Another **Electronics For You** badly-designed circuit, July 2013:
When the 22k mini trim pot is turned fully clockwise, the 9v supply will be directly across the FET inside the microphone and will possibly blow it up.

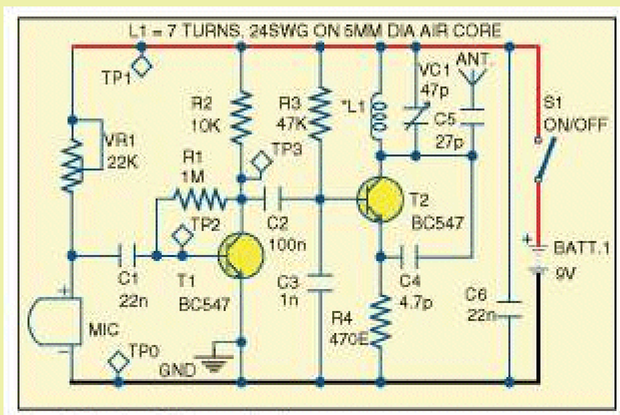


Fig. 1: Circuit of wireless microphone

Another **Electronics For You** badly-designed circuit, July 2013:

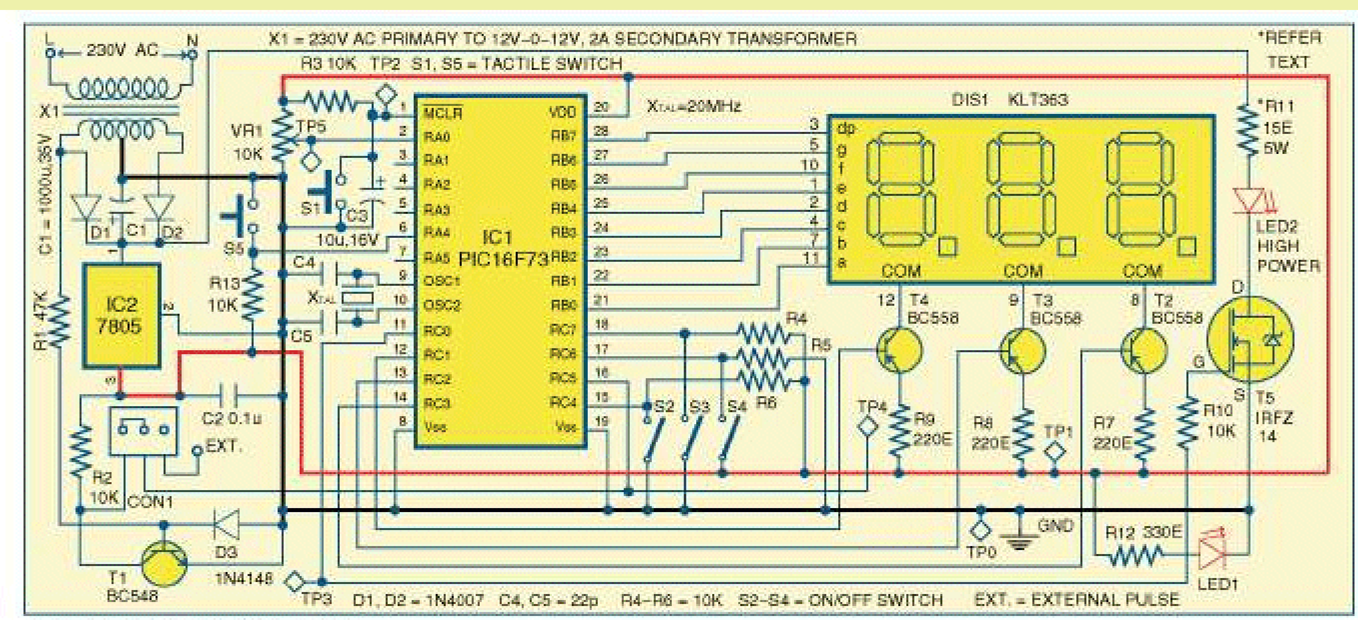
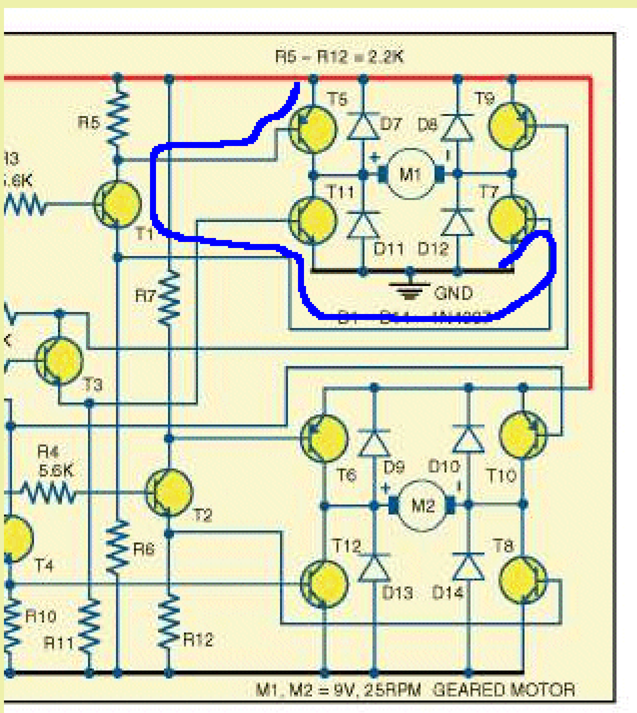


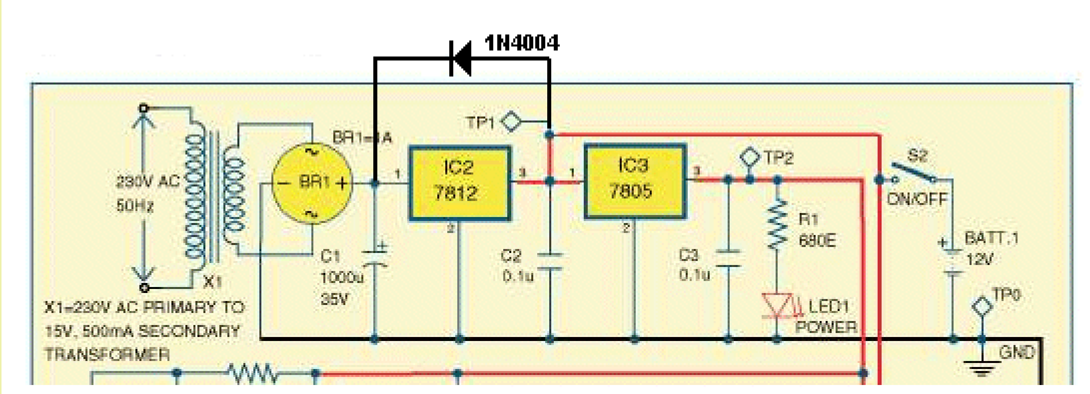
Fig. 1: Circuit of the LED stroboscope

Apart from the fact that the layout of the 7805 and driver transistors for the 3 digits on the display are all up-side-down and hard to follow, the PNP transistors for the display are badly configured. The drive-lines to the display should contain 220R resistors (7 x 220R) and the BC558 transistors should have no resistor.
The problem with the circuit above is this: As more segments on a particular display are illuminated, a higher current will flow though the 220R resistor and create a larger voltage-drop. This means the segments will get duller as more segments are illuminated.
The second poor design is the connection of the base of each driver transistor to an output of the microcontroller. This arrangement is absurd, as a low on the base of each transistor will fully turn it on and not allow the current to pass to the segments of the display. I don't know how they expect the circuit to work. It has obviously never been tested.
The next problem is the value of R11. The circuit suggests 15R. And the parts list suggests a 5watt high-power LED. Let's go through the mathematics. If you have a supply of 16v DC from the rectification of the 12v - 0v - 12v transformer, the voltage across a 5watt LED will be about 3.6v. This leaves 12.4v across the 15R resistor and thus 825mA will flow. This gives the LED .825 x 3.6 = 3 watts. The wattage lost in the 15R resistor will be 12 watts!!
If you put two LEDs in series, the result will be: 3.6v + 3.6v = 7.2v The voltage across the 15R will be 8.8v. The current will be 590mA and the wattage will be 8.8watts The wattage of the LEDs will be 4.2watts. Obviously the values provided by the author do not work. It is not good enough in the text to say: "select your own resistor." You need to provide details on how to select the value, especially when a high current is involved.

Another **Electronics For You** badly-designed circuit, July 2013:
This circuit contains 4 separate paths that will create a high current. We have shown one path consisting of semi-conductor junctions (with NO current-limiting resistor) and these junctions have a very low resistance when conducting. This means a very high current will flow and even though two of the three transistors are fully turned ON to drive the motor, the current-flow will be higher than required because no CURRENT LIMITING resistor has been included in the circuit. The current can be high enough to damage the transistors. This is a MAJOR fault.



Another **Electronics For You** badly-designed circuit, July 2013:
A protection diode is needed across the 7812 regulator to protect it from reverse voltage when the 12v battery is connected and the power from the mains is not present.
The 1,000u capacitor will be uncharged and the voltage on the output of the 12v regulator will be 12v when the battery is connected and may cause damage to the regulator. This 12v-difference may damage the regulator but if a 1N4004 diode is added, the voltage-drop across the diode will be only 0.7v and the regulator will be protected.



Another **Electronics For You** badly-designed circuit, July 2013:

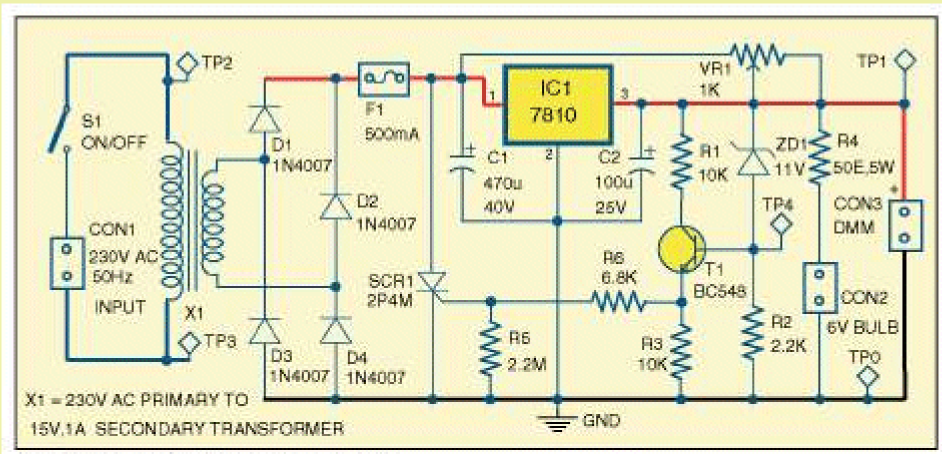
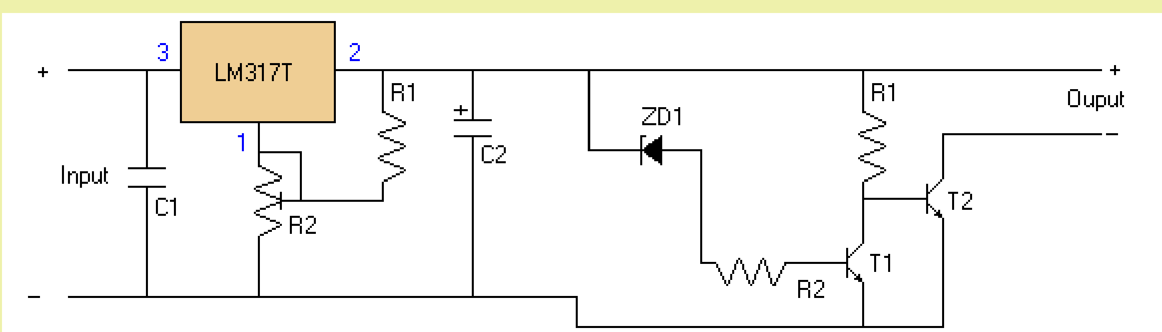
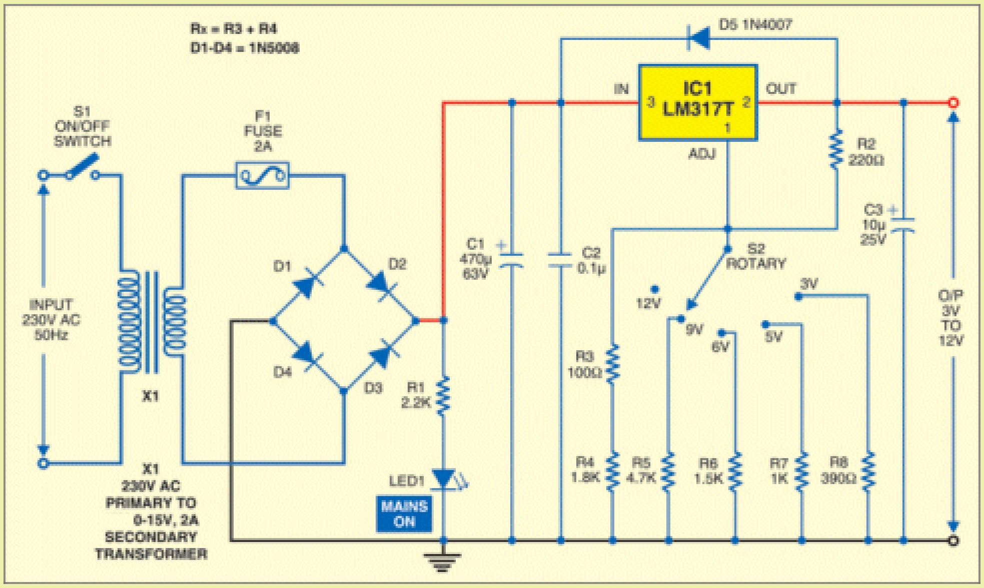


Fig. 1: Demo circuit for over-voltage protection

The circuit above detects an over-voltage and trips an SCR to blow the 500mA fuse. This is a drastic way to save an over-voltage condition and is called "CROWBAR PROTECTION."
In 40 years I have never heard of a voltage regulator failing and producing an over-voltage, even though I have sold thousands of power supply kits and thousands of computer kits using a 7805 regulator.
So I think the circuit is solving a problem that does not exist.
However, apart from this, lets look at the circuit and see the bad design features.
Firstly, a 7810 regulator is very unusual. If you re going to produce a "general circuit," the components should be commonly-used values.
Secondly, the 15v transformer will deliver 20v to the regulator and this will produce 10 extra volts across the regulator. At 500mA this amounts to 5watts. This could be the cause of the regulator failing.
The 1N4007 diodes should be specified as 1N4002 or 1N4004 as 1N4007 are 1,000 volt diodes and are only specified when voltage spikes can be of this magnitude.
Now we come to the BC548 transistor. What is the function of this transistor? It is not needed. The zener can be connected directly to the gate of the SCR, saving 4 components.
The following circuit switches off the output when the voltage from the regulator rises above a specified value and reconnects when the voltage falls.
The voltage will rise if the bottom terminal of R2 is removed from the 0v rail.

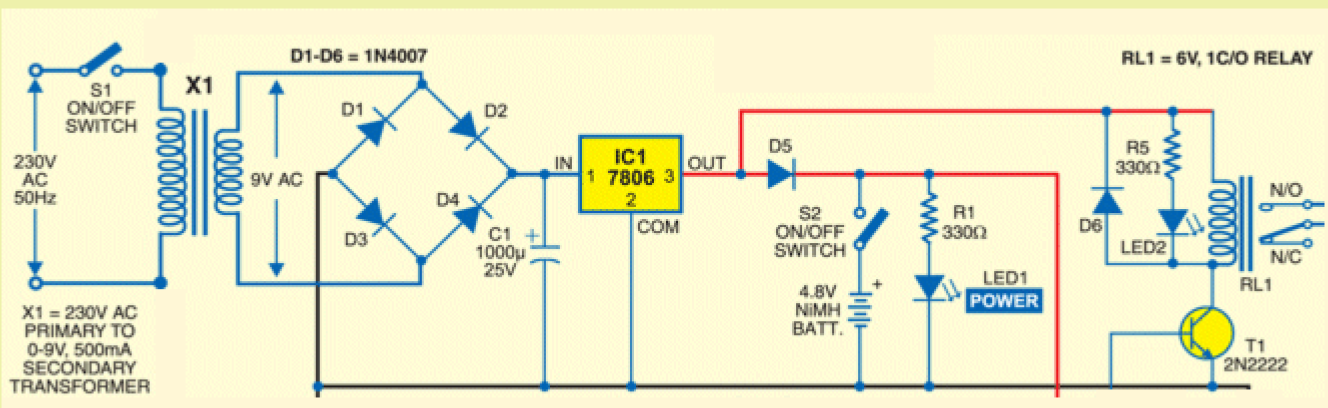


Another **Electronics For You** badly-designed circuit, July 2013:



This is a very dangerous circuit. The output voltage will jump to 12v when the switch is moved from 3v to 5v.
DO NOT BUILD THIS CIRCUIT.
The switching should be between the adjust pin and output.

Another **Electronics For You** badly-designed circuit, July 2013:



There is no current limiting resistor when charging the NiMH battery from the 6v regulator and the charging-current will be unknown.
NiMH batteries are very complex to charge and a simple charger like this will cause damage.
NiMH cells should not be charged above 1.78v per cell (5.25v total) and this charger will keep charging as the input voltage is 5.4v. Just a very dangerous circuit. Do NOT build this circuit.

Here is a technical reply with lots of mistakes:

I have a 1.5 watt solar panel battery charger. In full light it registers around 14+ volts and at least 1.5 watts. I would like to use this panel to power a small dc motor that I pulled from a portable CD player to use in a science fair project for my son. Whenever I hook up anything to this, it seems to drain all the power from the panel and does not power the motor. How can I figure out what I need to power a dc motor that typically runs off of 2 1.5vAA batteries (3v or less power).

I'm guessing the solar cells aren't big enough. - **this is incorrect - see why later.**

The motor probably pulls very little power with no load on it. I assume the motor you're trying to use is from the tray mechanism, it is a DC brush motor, not a stepper motor. **There is no tray mechanism on a 3v portable CD player. The motor the enquirer is using is a STEPPER MOTOR that spins the disc.**

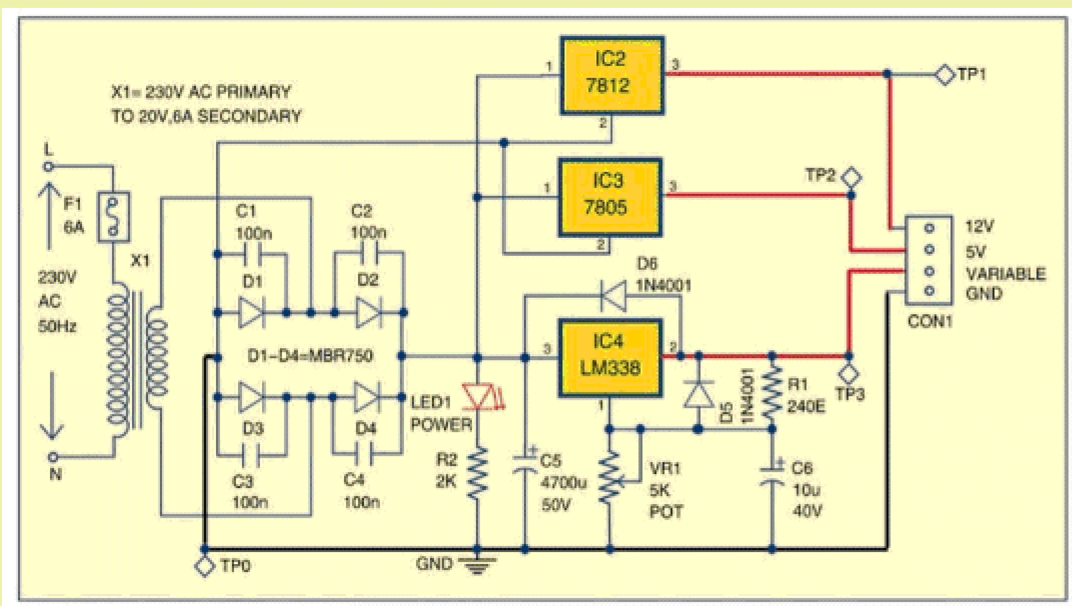
The spindle that spins the CD is usually a brushless synchronous motor, not something you just put DC on and it runs. The motor that runs the tray to eject the disk is probably a simple DC brush motor. There might be a third motor that moves the head back and forth, that is also usually a DC motor. You want to use one of these DC motors. These motors will probably run on 3V but pull right around 1.5W. **No 3v motor requires 500mA - 1.5watt. A 3v motor normally requires 70mA to 170mA.**

So they might not run unless you have full bright sunlight on the solar cells. Another issue is if you have solar cells that are made to charge batteries, they are probably not made to supply very much current, they are wimpy little things. Still, 1.5W at 14V is around 100mA, that might still be enough to run one of these motors. Try this - if you have a voltmeter that measures current **No voltmeter measures current - Shilpo Kapoor should say "Multimeter."**

connect it in ammeter mode right up to the two wires from the solar panel. That will put a dead short on the solar cells (an ammeter is always a short), but it will measure the short circuit current of the panel, and won't hurt the panel at all. Try it with indoor light, then sunlight. Put the meter on like a 200mA full scale mode. If you put the ammeter on 20mA full scale you might damage the meter in full sunlight. If you really want to be safe, use the meter's 10A scale first to see what range the current is. If the current reads like 10mA, it will never get the motor moving. If it's 100mA, it will probably try to run the motor, if you spin the motor you will find it wants to go one direction and resists going the other direction. You can also power the motor from 2 batteries and measure the current it is pulling while running.
Shilpo Kapoor, Lotur

You cannot connect a 3v motor to a 14v solar panel. As soon as you get a small amount of sunlight on the panel, the motor will "over RPM" and the armature windings will possibly be damaged.

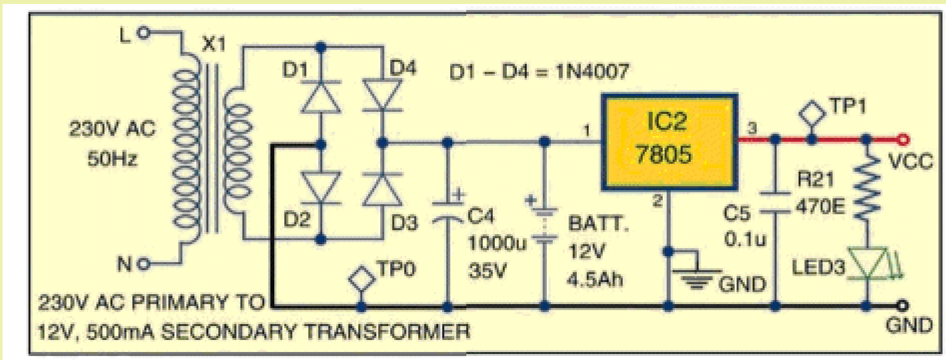
Another **Electronics For You** badly-designed circuit, August 2013:



This project has been submitted by ABHISHEK KUMAR a final-year student with absolutely no electronics experience AT ALL.
The rubbish he is presenting is passed to 50,000 readers of the magazine and many will experience problems with the power supply.
Let's look at the first problem. When a transformer states 20v AC secondary, the voltage will be 20v at full load. All transformers have a term called REGULATION. This means the output voltage will be slightly higher than 20v when the current is say 1amp, because the as the current increases, the resistance of the secondary winding will cause a slight voltage-drop. This means the no-load voltage will be about 23v to 25v.
The author states the output voltage will be 28.2848 volts after the rectifier. What an absurd thing to say when the AC voltage can be anything from 20v to 25v. You cannot state an accuracy with more figures than the given data.
If we take the 7805 and try to draw 1 amp, the voltage across the 7805 will be 25 x 1.414 - 1.4v = 34v - 5v = 29v. Wattage dissipated as heat will be 29 watts.
The regulator is designed to allow a maximum of 15 watts to be generated as heat and this means the regulator will only allow 500mA load.
The same applies to the 7812, with about 700mA load. I am not going into the finer details because the circuit is so badly designed that I would not construct it.
For the LM338, the situation is just as bad. The metal-can version of the regulator can dissipate up to 50 watts, and this is just like the heat of a soldering iron. 50 watts is a LOT OF HEAT! The plastic version (as shown on the diagram

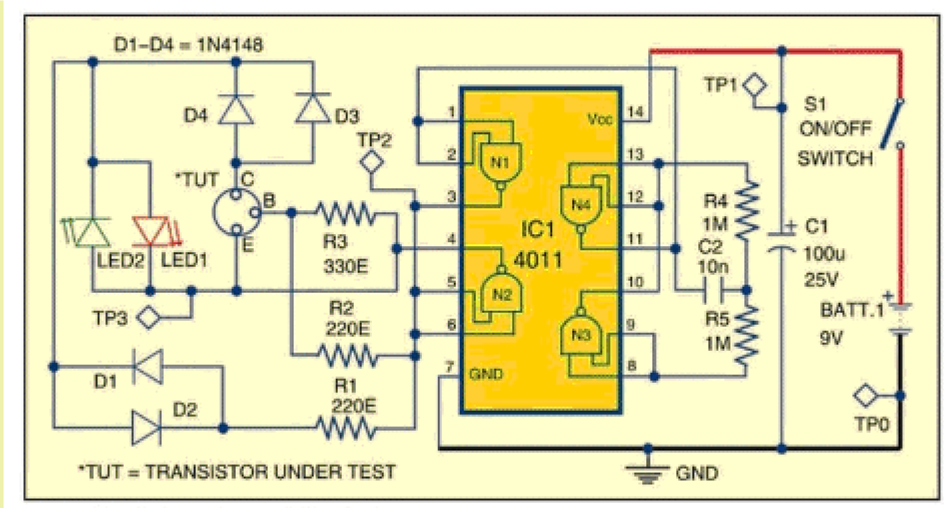
with leads marked 1,2,3) dissipates a maximum of 25 watts.
Suppose you adjust the LM338 to output 10v at 5 amps. This will produce 20 x 1.414 - 1.4 = 26.8v -10v = 16 x 5 = 80 watts. The chip cannot deliver more than 3 amps due to the badly-designed power supply.
The output of a regulator should have a 100n and 10u electrolytic to prevent parasitic oscillations (1MHz oscillations). These capacitors need to be close to the regulator to have any effect.
None of this has been considered by the author or the Technical Director of the magazine **Sani Theo**.
I have repeatedly told **Sani Theo** to contact me before publishing rubbish like this, but he doesn't have the intelligence to get these circuits analysed before publication and continues to deliver this rubbish to the readers of the magazine.

Another **Electronics For You** badly-designed circuit, August 2013:
This circuit has been produce by **Dr D.G. Vyas**. The states he is in-charge head, department of Physics and Electronics, Hem. North Gujarat University, Patan

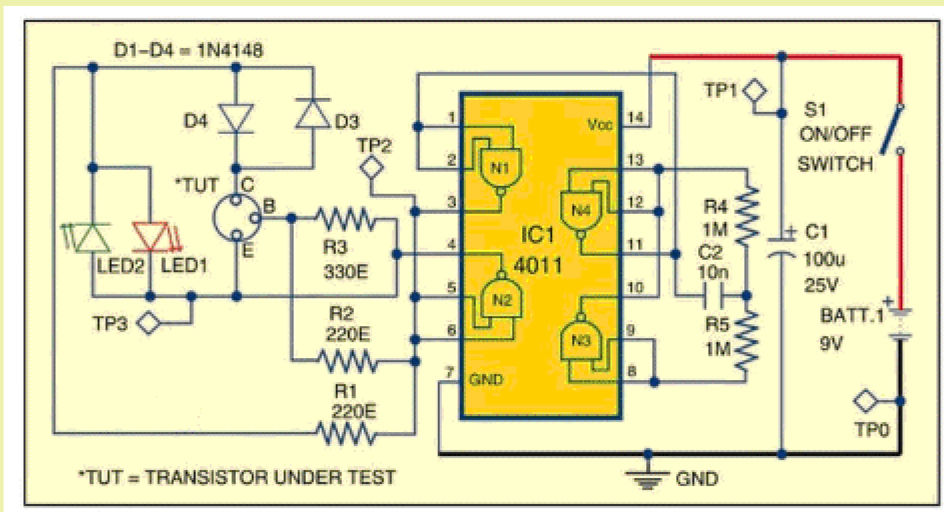


He has no electronics knowledge AT ALL.
You cannot connect a transformer to a battery and expect it to charge the battery without overcharging.
But most-important, you cannot connect a transformer to a battery as the transformer will BURN OUT.
The circuit above is one of the worst circuits I have seen. It does not matter if you are a Doctor, Professor, or student, test and check your circuit before sending it to a magazine, where lots of intelligent readers will see the badly-designed circuit.
Here's the point that no-one has mentioned before. A battery is just like a zener diode. It sits in the circuit just like a 15v zener diode when it is fully charged.
If you have a transformer capable of delivering more than 15v, current will flow into the battery. Just because the transformer is rated at 500mA, DOES NOT mean that 500mA will flow. A lot more than 500mA will flow and the actual current-flow is unknown, but will depend on the resistance of the secondary winding. It could be as high as 1 amp or 2 amp and the transformer will definitely BURN OUT.
No only will the transformer get very hot and eventually burn-out, but the current into the battery will not reduce when the battery is fully charged and it will start to "gas" and dry-out very quickly.
You MUST have a voltage regulator to supply the exact voltage when charging a battery or deliver a trickle charge so the battery will not "dry-out." None of this was mentioned in the article.
The remainder of the project uses 7-segment displays that are not carried by any parts-supplier. Obviously the author has dug up some "junk bits" without making any effort to see where they can be purchased.
I'm glad **Dr D.G. Vyas** is not my lecturer.

Another **Electronics For You** circuit with mistakes, August 2013:



D4 should be reversed and D1, D2 are not needed:

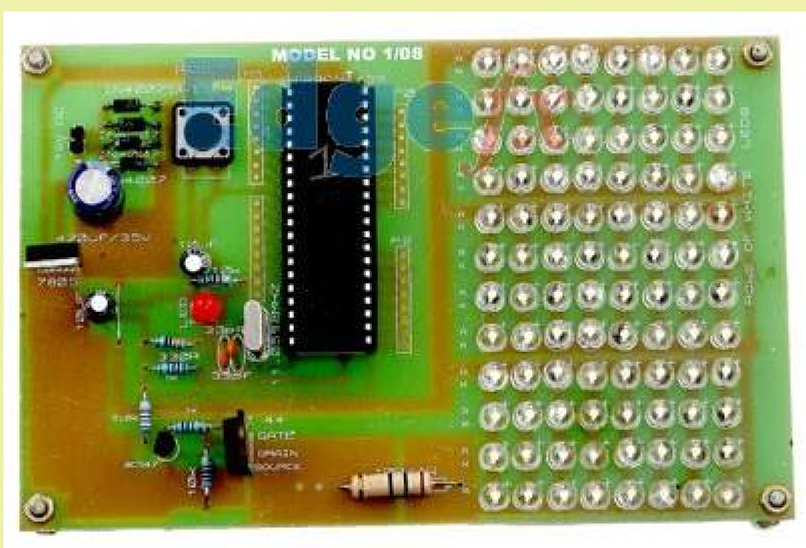


When designing a circuit, ask yourself this simple question: Is this component needed? remove the part and see if the circuit works. The combination of D1 and D2 will pass current, no matter if the polarity of the supply is positive or negative. Thus they are not needed. Another untested circuit from **Electronics For You** magazine.

Edge FX wanted me to recommend their site and provide a link.
Look at just one of their kits. A voltage multiplier:

Look at the bare connections at the end of the 240v power lead !!!!
Look at the 1,000v diodes soldered on top of each other !!!!
The kit contains 100u electrolytics. Can you imagine the current that can be supplied by the multiplier circuit !!!
It looks like the electrolytics are connected in series. Why ??? You can get 100u @ 415v
The kit costs $289 !!!!
Now have a look at where they are reading the output voltage !!! They have the voltmeter connected to the 2,000v end of the generator !!!!
The voltage divider consists of 10 resistors to divide the 2,000v to produce 200v across a single resistor but they are reading the HIGH END and not the "EARTHY END" !! The voltmeter will have 2,000v on it !!
Edge FX has **NO IDEA** how to design a kit and this kit is one of the worst, **MOST DANGEROUS** kits on the market.
You can imagine why I didn't recommend their site.

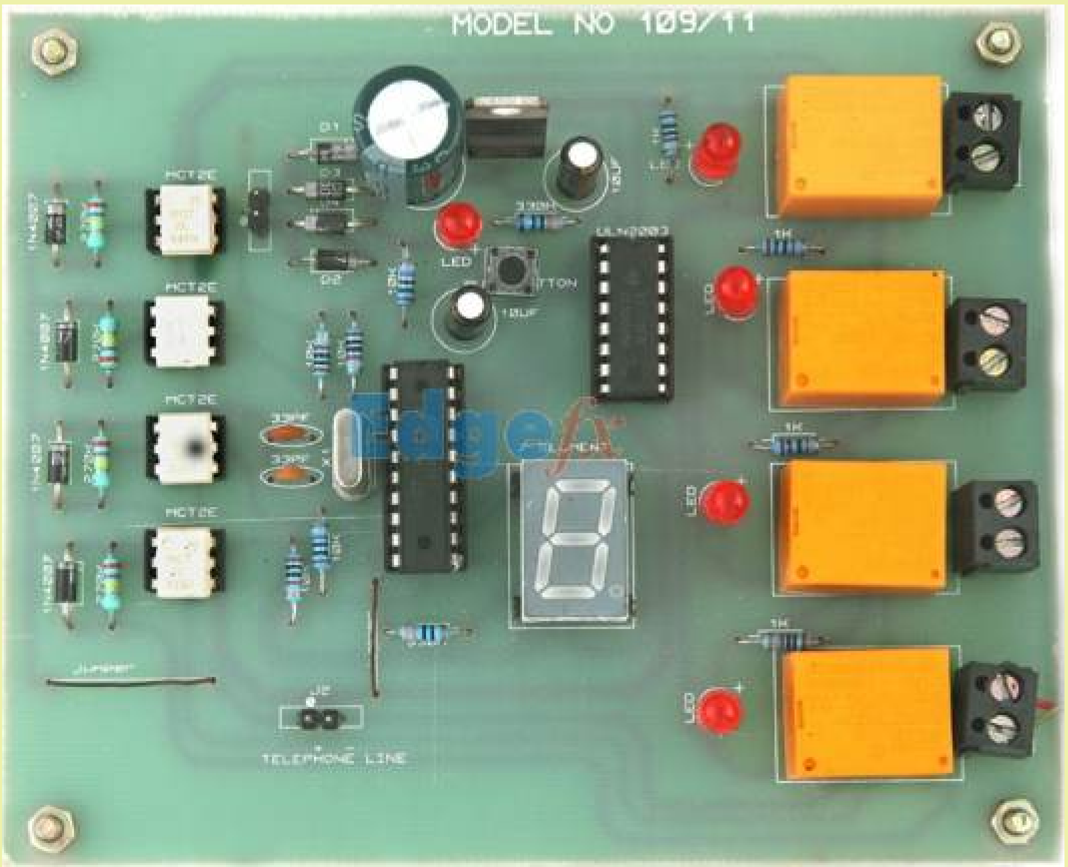
Here is another absurdly over-deigned, over-priced ($219) design from **Edge FX:**



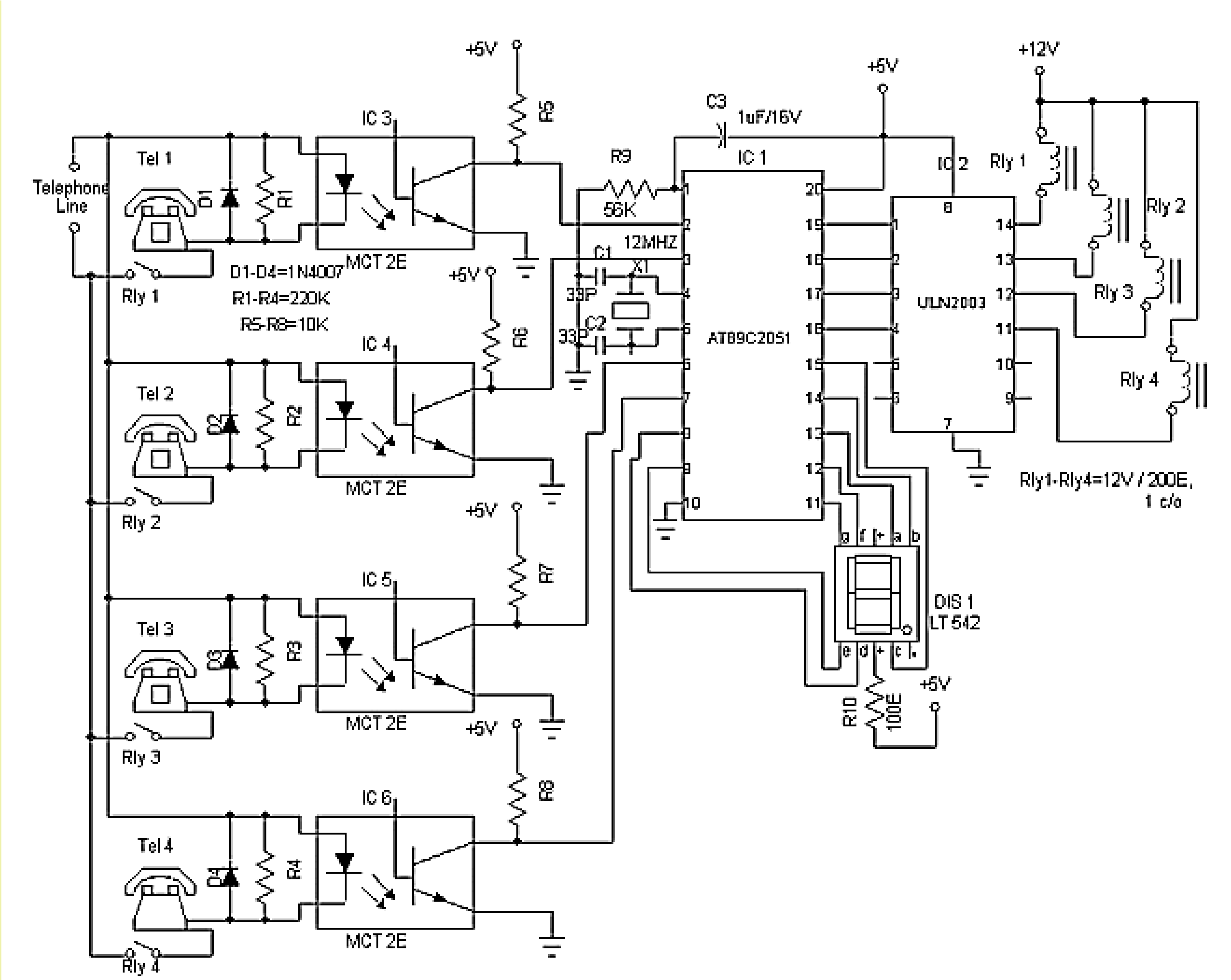
The circuit is designed to increase and decrease the brightness of the LEDs. The LEDs are supposed to be a lamp, but they are next to all the extra circuitry and the project is not very practical.
The 8051 microcontroller is HUGE. All the project needs is an 8-pin PIC micro.
The LEDs have only a single current-limiting resistor. This is a BIG MISTAKE. Very poor design.

The current limiting resistor is a very low value and this gives the circuit a very small supply-voltage HEADROOM. This is something the designer knows nothing about.
The text does not say if the project is operated via a timer to raise and lower the brightness of the LEDs according to the time of day or if a photocell is included to adjust the illumination. Since there is only one input and one output, a very small micro is needed.
Just another JUNK project with very poor design-features and a price that would scare almost all electronics engineers.
If you can't produce a project like this for $20.00 or less, you are in the wrong market. No-one is going to buy a lamp for $219.00
They are trying to sell their projects to **desperate** final-year electronics engineers who can't design their own project.
They think EVERYONE'S a **FOOL**.

Here's another ($229) design from **Edge FX:**



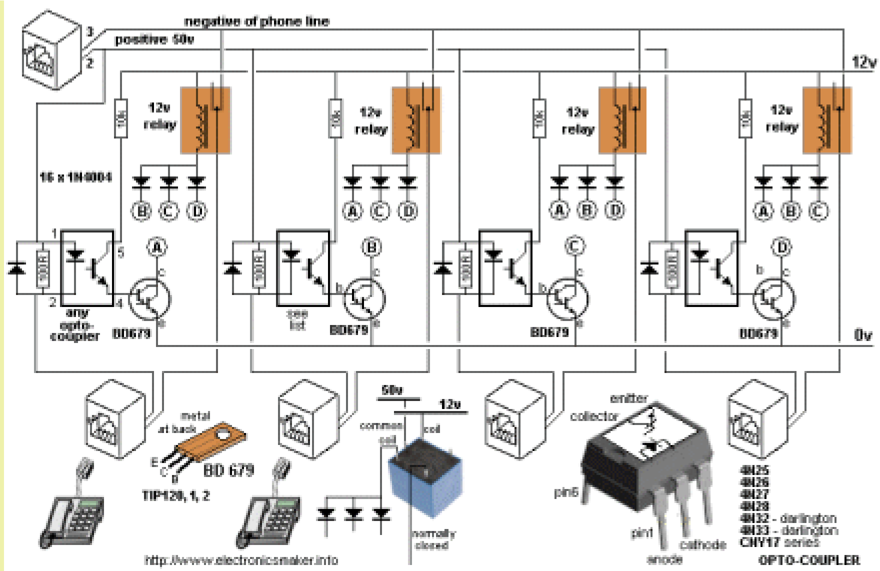
It connects 4 parallel phones to the phone line and only allows one phone to receive the incoming call. The circuit has been copied from a project on the web and the mistakes in the circuit have been copied without any corrections. Note the 220k across the LED on the opto-coupler. It should be 100R



[Click for full size image](#)

It is not obvious from the diagram, but the relay contacts are normally closed so that all the phones are on the phone-line when the incoming signal (ring signal) is received. This is an AC signal and will not have sufficient current to illuminate the LED in the opto-coupler.
When one phone is lifted, the corresponding LED in the opto-coupler illuminates because the phone draws the phone line down from 50v to about 12v and takes about 20mA to 40mA. The resistor across the LED should be about 100R so that some of this line-current flows through the resistor.
The transistor in the opto-coupler turns on and produces a LOW on the corresponding input to the microcontroller.
The micro turns on the other three relays so that other phones are removed from the phone-line.
When the phone is put down, the relays are de-energised.
The project above has LEDs corresponding to each relay and there is no need for the 7-segment display.

This circuit can be created with gating diodes and a few components. Here is the circuit:



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SPOT THE MISTAKES!

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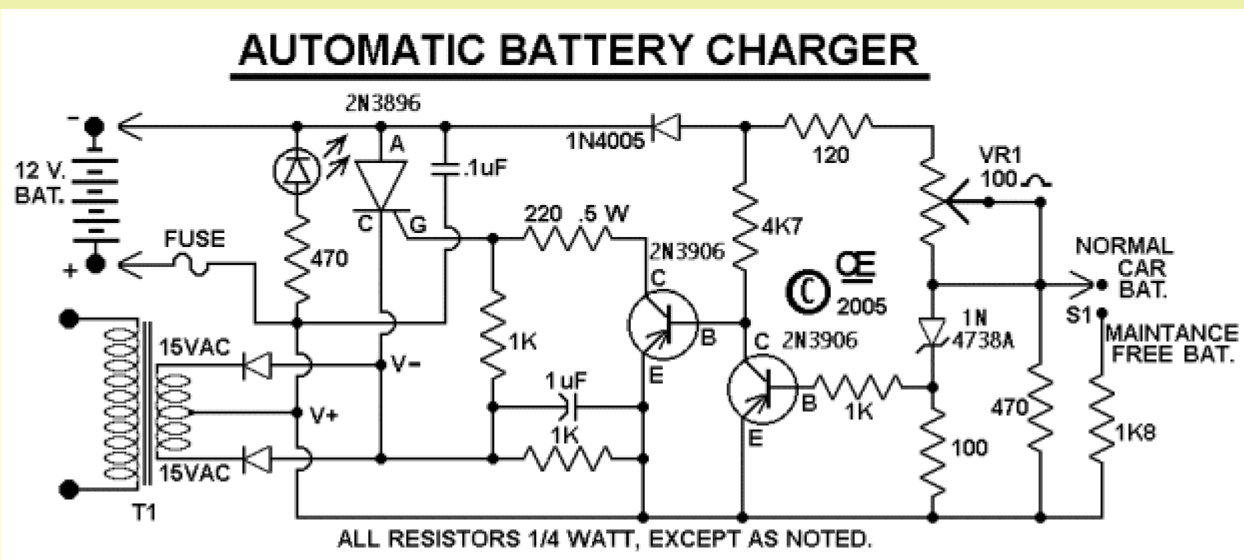
You cannot design a circuit and put it on the web without doing your homework.
Homework consists of researching the number of circuits that have already been designed; and testing your circuit for faults, reliability, unnecessary components and current consumption.
Many designers (especially from **Electronics For You** Magazine) consider a circuit to be successful if: "IT WORKS."
Every components in every position has a range of "design values" that lets the viewer understand what the component is doing.
If it is outside this range, a qualified engineer will look at the circuit and try to work out why the particular value has been chosen.
This is a point that has never been discussed in any text book and is one of the main underlying points behind the SPOT THE MISTAKE articles.
Identifying faults in a circuit has never been done before and this is possibly why there is such a proliferation of mistakes in magazines and on the web.
There are lots of hidden, technical mistakes that go unchecked and don't show up until something gets damaged.
Having fixed over 35,000 electronic devices including TVs, amplifiers, etc I approach every repair with the attitude: why did it fail? how did it fail; and how to prevent a future failure.
The same applies to every circuit on the web.
Has it been designed correctly?
Are there weak points in the design?
Are there unnecessary components?
With this attitude you have a head-start to designing a fault-free circuit.
I know SPOT THE MISTAKES gets very few readers out of the 5,000 visitors each day, but over the 25 years of writing articles, I have helped many readers to achieve great results, and although this may represent only 1 person in 10,000 it is about the recognised percentage for electronics wizards.

You can see a recent email from a reader of Talking Electronics Magazine who attributes his success to "getting in early," reading my articles and "taking it all in."

BATTERY CHARGER FAULTS

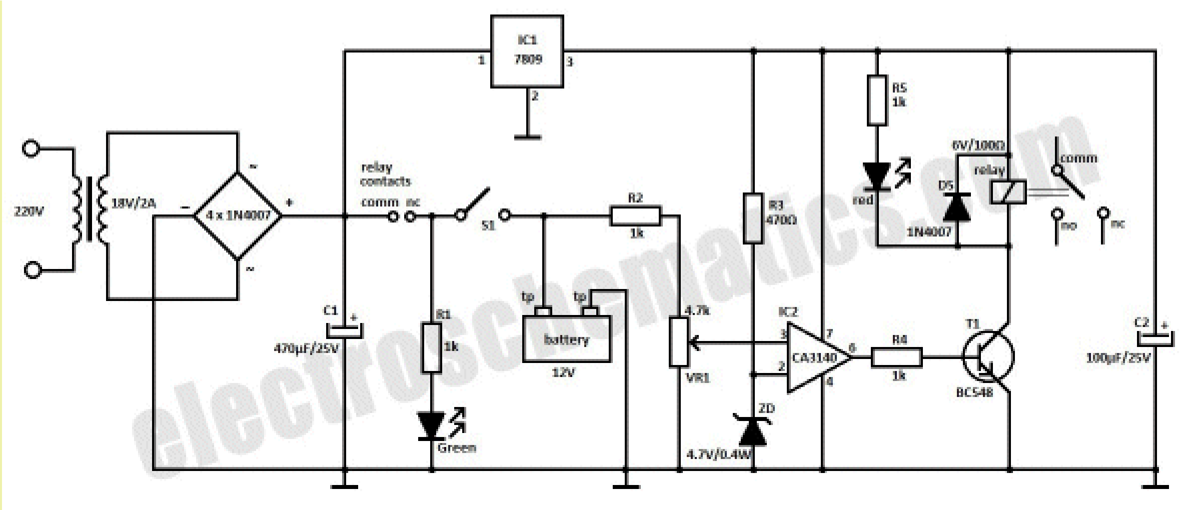
There are lots of battery charger circuits on the web and many have major faults.
It is obvious the authors have not tested them.
Some circuits are so badly designed that the transformer will burn-out or the battery will dry out in a short period of time.
The main problem is this: **It is very difficult to charge a battery. You simply cannot connect a battery to a transformer and expect it to work.**
Batteries have different cut-off voltages (the maximum voltage that can be applied to the battery before "gassing" occurs) due to the composition of the paste applied to the lead plates.
Some compositions prevent the cell “gassing” until a higher voltage is reached during charging and this allow the battery to be classified as “Sealed.” This means you can fully charge the battery and providing the charging voltage does not reach this specified voltage, the battery will not produce any gasses. Other led-acid batteries are ordinary cells and have a lower cut-off (gassing) voltage.
You can detect (monitor) this voltage with a meter or have an electronic circuit detect the voltage.
There are two ways to charge a battery. Manually or automatically.
An automatic circuit MUST reduce the current to a very small amount (or zero), then the "gassing voltage" is reached to prevent the battery DRYING OUT.
If charging a battery manually, it must be disconnected when the "gassing voltage" is reached.
You cannot simply connect **any** transformer to a battery.
A battery-charger transformer is specially designed to produce an output voltage (after rectification) that is exactly the required voltage. The secondary winding will be accurate to "half a turn."
In addition, the transformer must be low-impedance so it will deliver a current right up to the point of “cut-off” and taper the current to almost zero when the "gassing voltage" is reached.
This is very hard to do without electronic detection circuitry and even 100mA being delivered to a battery over a long period of time will eventually dry it out.
One other factor to take into consideration is this:
If the battery is being used each night for say illumination, and the battery is charged each day, you need to work out if the charging circuit will fully charge the battery in the remaining hours of the day.
Most chargers work on a 14 hour-rate. The charger delivers 10% of the amp-hr rate for 14 hours.

Here is the type of faulty battery charger circuit I am talking about:

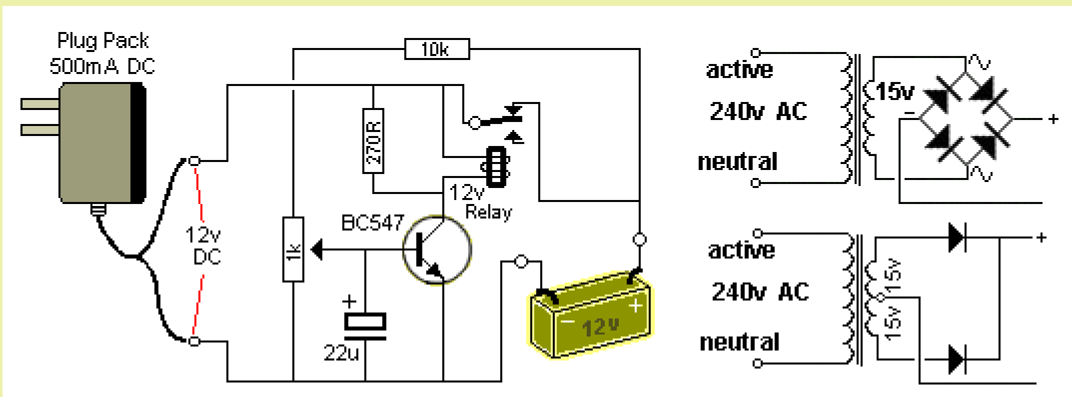


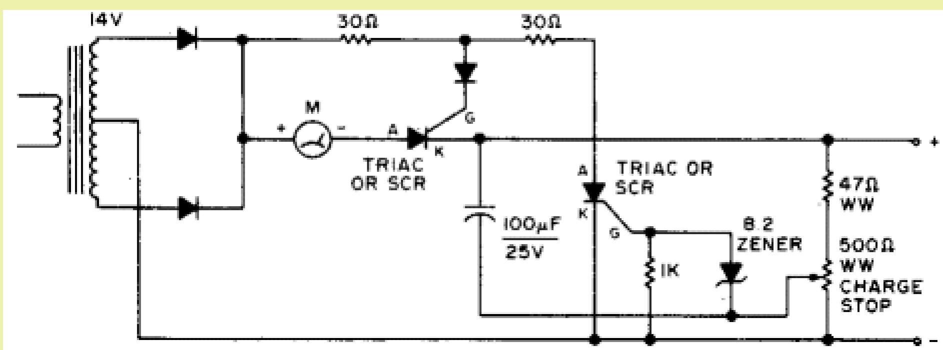
The transformer will produce 15v x 1.4 = 21v - 0.6v = 20.4v
The battery is just like a zener diode and its maximum voltage will be 15v when fully charged. This means a voltage of 20v will be delivered to a device (battery) that has 15v across it. Since there is no current limiting device between the two voltages, a very high current will flow and this current could be high enough to burn out the transformer or the diodes.

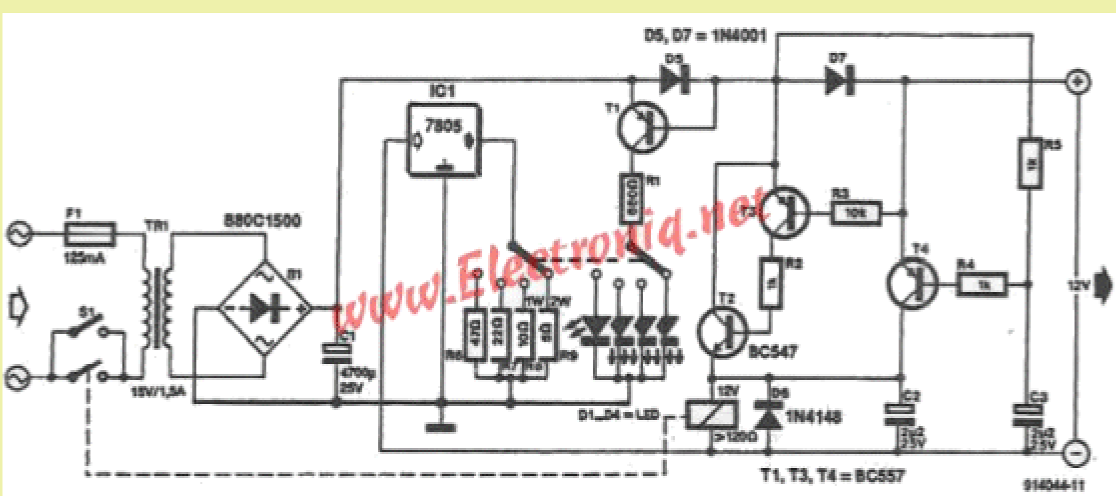
Here is another battery charger with the battery connected directly across the power-supply:



Another faulty circuit:

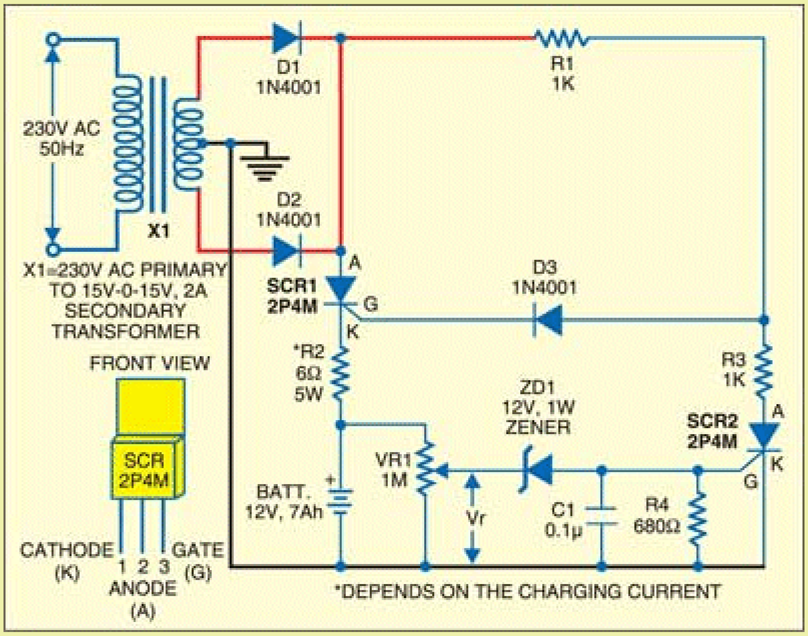






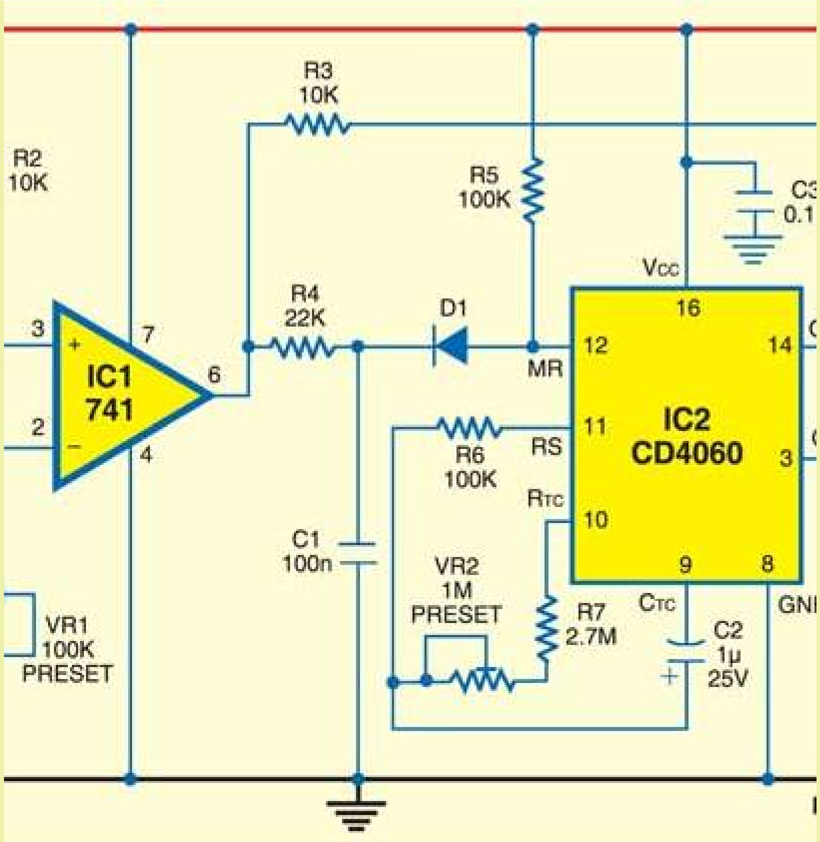
From these circuits you can see problem.
No current limiting resistor between the transformer and battery means an unknown high current will flow.
Some of the circuits will turn off when the battery voltage reaches a maximum value, but the transformer may already be overheated.

This circuit has a current-limiting 6 ohm resistor. This value is not a standard value and maybe you can use 2 x 3R3 3watt resistors in series. The 1N4001 diodes limit the current to about 1 amp (or slightly more) and when this current is flowing, the 6R resistor will drop 6 volts. This resistor is very important to limit the current and prevent damage to the circuit.



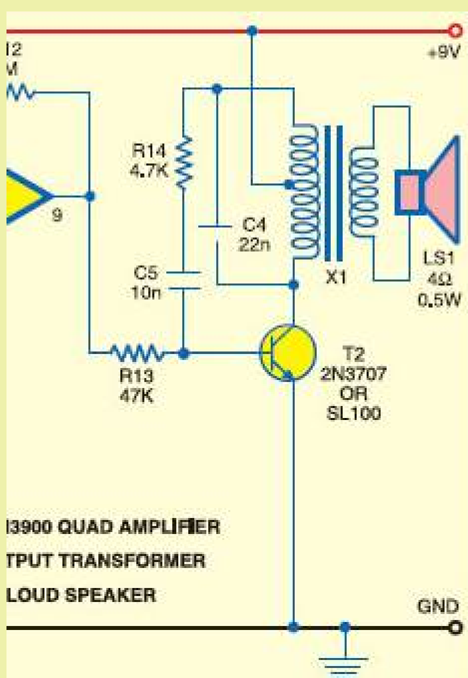
Why will (does) a battery-charger transformer BURN OUT?
Connecting a transformer to a battery is a very risky (dangerous) thing to do.
A battery is just like a zener diode. If you supply a voltage just below the value of a zener, no current will flow. If you increase the voltage to the exact value of the zener, a current will flow. If you increase the voltage slightly, a lot more current will flow. That's why you need a resistor between the supply and the zener. The resistor will limit the current.
The same with a battery connected to a transformer. If the output voltage of the transformer is slightly higher than the voltage of the battery a high current will flow. The exact amount of current will depend on the construction of the transformer and the thickness of the wire in the secondary winding.
Because the size of the current is unknown, you need a current-limiting resistor and an ammeter to check the current. There is no formula because we don't know the number of turns on the secondary, the turns on the primary, the type of material in the core or any of the other factors.
However you can consider the transformer is driving into a short-circuit. Just like a 5v transformer driving into zero ohms, a 20v transformer driving into a 15v battery will deliver more current than expected and overheat the transformer.

More faulty designs from **Electronics For You** magazine:



The supply is 12v and the reset line (pin12) needs to see a voltage below 3v for a guaranteed reset. The LOW of ICI (pin 6) will be about 0.5v and diode D1 will drop 0.7v. The voltage divider made up of the 100k and 22k will drop 2.5v. This gives a total of 3.7v. This will not guarantee a reset for the CD 4060 chip. Just another bad design.

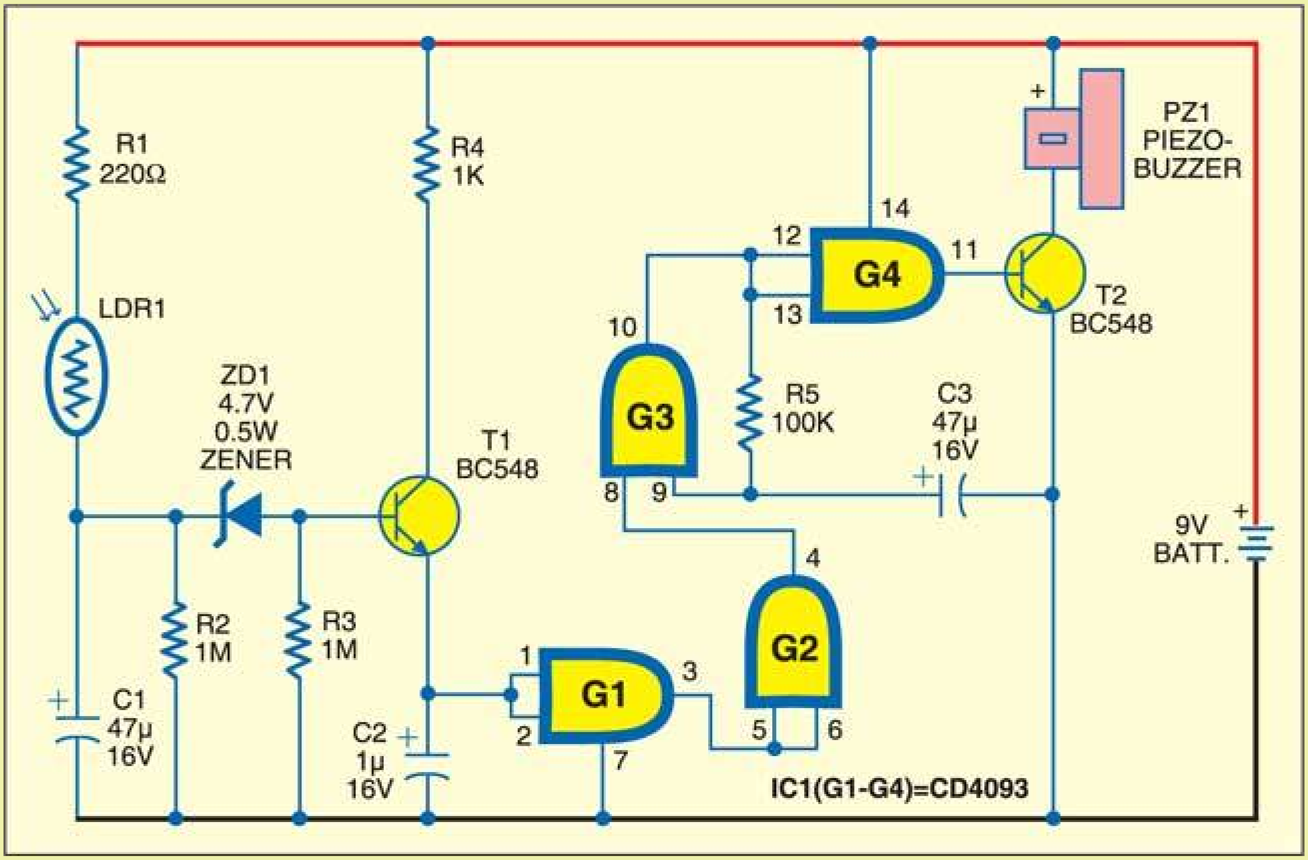
Another faulty design from **Electronics For You** magazine:



The 47k base resistor will allow 0.2mA to flow into the base. If the transistor has a gain of 100, the collector current will be 19mA. If the gain is 200, the collector current will be less than 40mA.

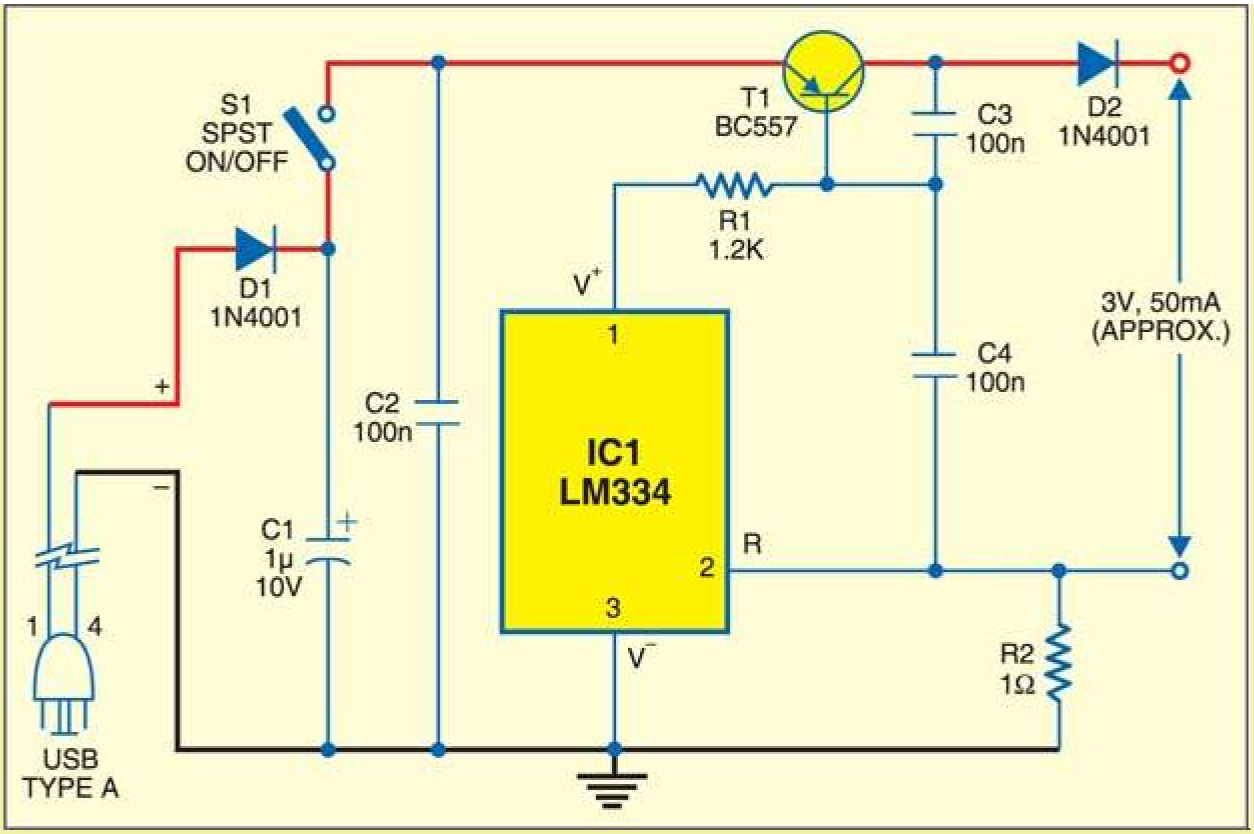
But when the transistor is driving an inductive load such as an audio transformer, the gain of the transistor is considerably LESS.
The audio transformer is classified as 1k:8ohms. This means the primary has an impedance of 1,000 ohms at about 400 to 800 cycles. In other words the primary appears as a 1k resistor. But the actual resistance of the primary will be only about 100 ohms and because it appears as such an unknown value of "resistance" the gain of the transistor will be considerably less than 200 or even 100.
The gain of the transistor will be 100-200 when the collector current is about 1mA to 10mA, but when the current is increased to 50mA to 100mA, the gain drops considerably. For this circuit the gain of the transistor will be no more than 70. But to get the transistor to drive a current though the primary of the audio transformer requires the transistor to be drive harder than expected. This means the base resistor must be in the order of 2k2 to 4k7.

Another faulty design from Electronics For You magazine:

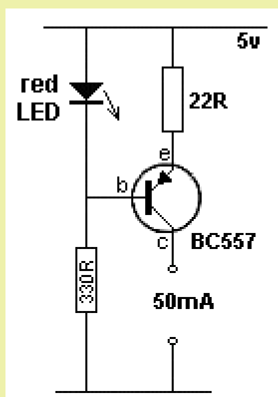


CD4093 is a NAND Schmitt Trigger. It has not bee drawn correctly. The input of a Schmitt Trigger needs to see about 65% or more of rail voltage to guarantee a HIGH input.
Pins 1,2 will see less than 65% and the circuit will not work.
The voltage across the zener will be about 4.7v and the drop across the base-emitter junction of T1 will be 0.65v, making a total of 5.25v. This produces less than 50% for the input of the gate. Another bad design.

An over-designed circuit from **Electronics For You** magazine:

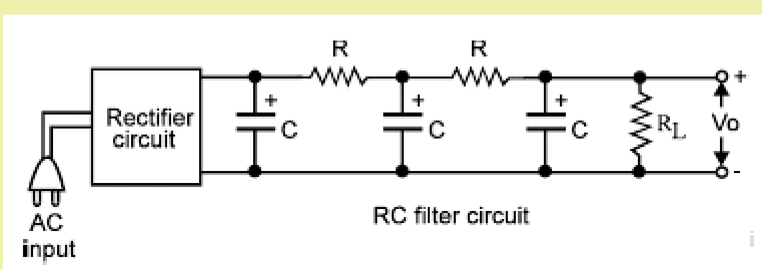


What is the point in using a chip to produce 50mA current-limiting when the whole circuit could be created with a single transistor and three components:

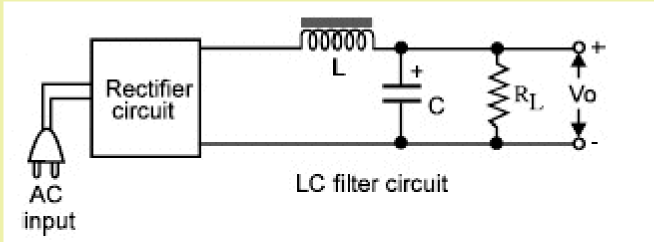


You never mention VOLTAGE when talking about a CONSTANT-CURRENT circuit. That's because the supply-voltage must always be HIGHER than the voltage required by the device being supplied the current and the supply-voltage can be MUCH HIGHER than required as the excess voltage will appear across the transistor and lost as HEAT.
Not only is the original circuit far too complex but the mention of 3v is inaccurate and has no relevance to the output as the actual voltage will depend on the number of cells being charged.

Here are some mistakes from Professor **Vidyasagar Sir** website:[Vidyasagar Sir's Electronics Web](). It is clear he does not know what he is talking about:



Each RC section creates some voltage drop, so it is only suitable for low output voltage applications.
This is UNTRUE It is only suitable for LOW CURRENT applications as the current creates the voltage-drop across each section.



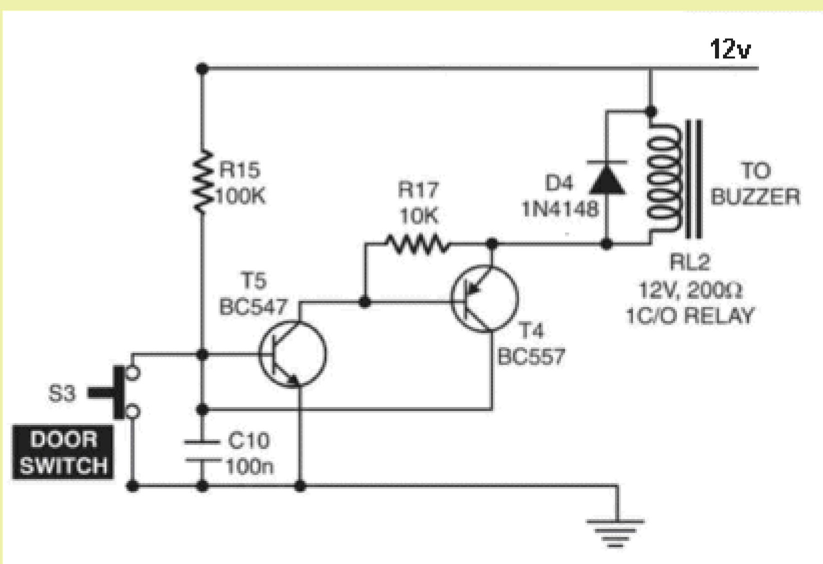
L is an inductor but if a choke is used the filtering action will be better. UNTRUE
An Inductor and choke are the same thing.

Advantages of LC filter:
Current flow is continuous - What does this mean ????
The transformer can be used very efficiently - What does this mean ????
The filtering action of the circuit is independent of load current - what **RUBBISH**. **ALL** filtering networks create a larger ripple when the current increases.

In this circuit, an inductor is connected in series with a load resistor. The inductor opposes any variation in the current flowing through it. Thus, when a changing current from the output of the rectifier circuit flows through the inductor, a back e.m.f. is produced across the inductor. This prevents the variations in load current. This circuit is suitable for low voltage and high current. UNTRUE. **It is suitable for any voltage.**

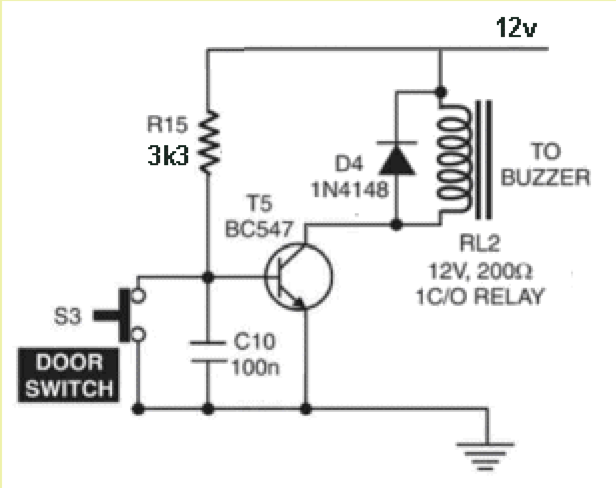
The above explanation is very hard to follow.
Here is clear definition.
Suppose the current though the inductor is pure DC. Very little voltage will be dropped across the inductor because it has a very low resistance. But it will have a very slight voltage across it that is slightly more-positive on the input terminal.
But if the current increases, the expanding lines of magnetic flux will cut each of the turns in the inductor and create a voltage that adds to the existing voltage. Suppose the voltage from the rectifier increases. This will increase the voltage through the inductor and the inductor will create an increased voltage to oppose the incoming voltage and thus the increased current will not flow. And the voltage on the input will rise. We call this a "back e.m.f." because it is coming out of the inductor to oppose the change in current.

Here's how NOT to design a circuit:



When the switch is released, the BC547 turns ON via the 100k and the collector-emitter current turns ON the BC557. This activates the relay and 60mA flows through the coil. This current flows through the base-emitter junction of the BC557. A transistor is not designed to pass this amount of current via the base.
The BC557 turns ON and since the collector is connected to the base of the BC547, both transistors are turned

ON in a LATCH arrangement. However the 60mA flows through the base-emitter junction of the BC547 and this is not a good design.
There is no need to have a latching arrangement. The application only needs a single transistor to operate the relay with a 3k3 base resistor:



Here's a totally absurd question from Earl Boysen and Harry Kybett's book for beginners: **COMPLETE ELECTRONICS SELF-TEACHING GUIDE** with Projects:

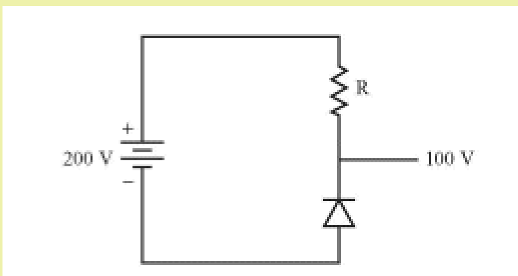


FIGURE 2.25

The diode in the circuit shown in Figure 2.25 is known to break down at 100 volts, and it can safely pass 1 ampere without overheating. Find the resistance in this circuit that would limit the current to 1 ampere.
When the diode breaks down with 100v across it, the wattage dissipated in the diode will be 100 WATTS!
How could **Earl Boysen and Harry Kybett** allow a stupid question like this to appear in their beginners book??

The Voltage Divider is covered in the text book but no mention is made that the output voltage will drop when it delivers a current to a LOAD. The beginner will get the impression that it is ideal for supplying a voltage and current. It is the worst arrangement for supplying a current to a LOAD. This arrangement is wasteful, inefficient and rarely used. 3-terminal regulators and Switch-Mode Power Supplies have taken over from voltage dividers.
The text states: **The object of this circuit is to create an output voltage that you can control.** This statement suggests the circuit is a good design. This is FAR from the truth.

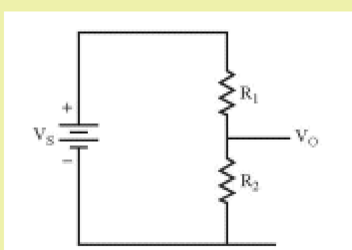


FIGURE 1.7

Here's another absurd experiment:

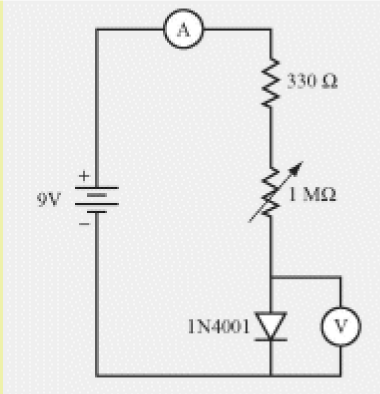


FIGURE 2.11

How can you adjust a 1M pot to a value such as 10k or less? This is an absolutely impossible task. It shows that **Earl Boysen and Harry Kybett** have no practical electronics experience AT ALL.

The book highlights the need to turn OFF the transistor with a base resistor connected to 0v rail:

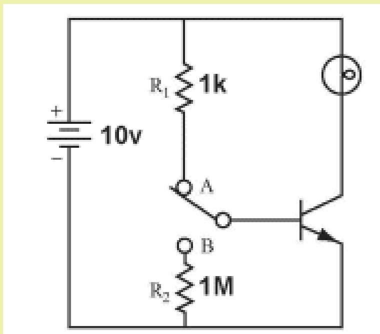


FIGURE 4.8

The 1M resistor is NOT NEEDED. The base can be left floating. Only a microscopic current will leak into the base and allow much less than 1 microamp to flow in the collector-emitter circuit. If the transistor is DC coupled to another stage, a current of less than 1 microamp will flow in the collector-emitter circuit of the second transistor. This sort of complexity need not be explained to beginners.

The text book goes on to cover biasing the base via two resistors. It does not explain WHY this is done:

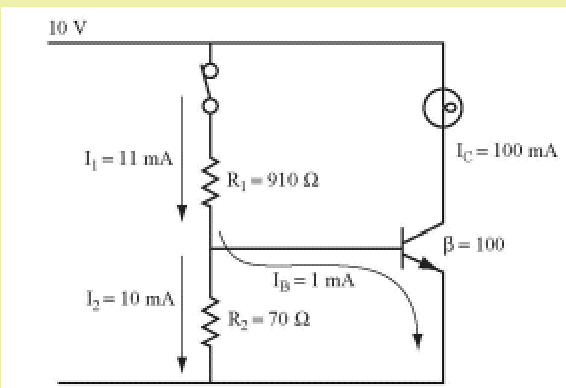
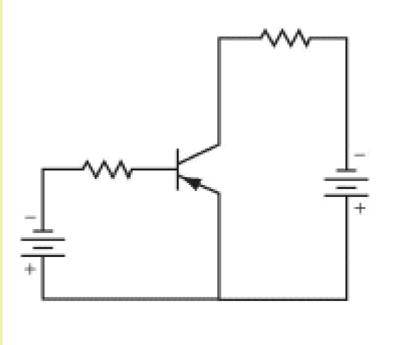


FIGURE 4.21

There is no point in adding the lower resistor. It does not change the fact that the circuit is impossible to analyse.

Look at the following diagram. What a stupid way to draw a circuit. Convention ALWAYS says to draw a battery with the negative at the bottom to create the 0v rail. This is the sort of rubbish they are foisting on beginners. The book should be BANNED!!!



Then they ask a stupid question like: Which way do the currents circulate? - clockwise or anticlockwise?
The current circulates according to how the circuit is drawn!!!!

Here is a bad example:

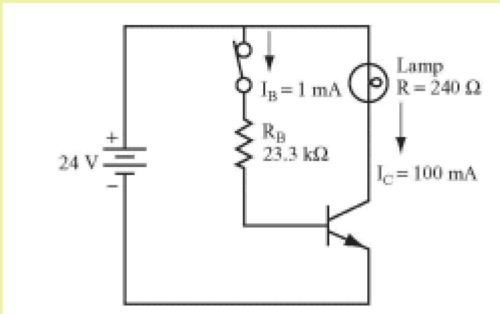


FIGURE 4.5

A lamp takes six times more current to get it to turn ON because the resistance of the filament is much lower when it is cold. If the lamp resistance is 240 ohms when cold, it will be over 1k when hot. So the example is a disaster. This fact is not mentioned in the text book. Wait until the beginner gets into the REAL world and finds the circuits he has been shown DO NOT WORK !

The text book spends far too much time on the Common Emitter stage as shown in the following diagram:

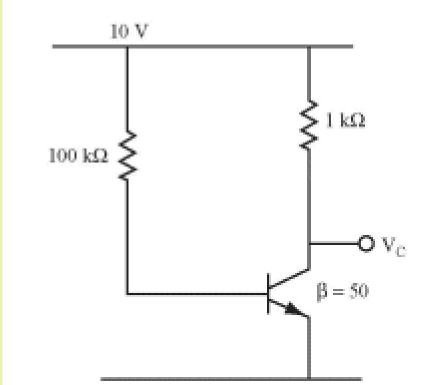


FIGURE 3.27

The circuit above is NOT a practical circuit because transistors have a gain of 50 to 100 or even 200 and the collector voltage will be much higher or lower than the expected mid-rail voltage. The book discusses this type of circuit in lots of detail, then goes on to talk about the bridge-biasing stage and all the previous discussion is wasted.
It does not cover the self-biased stage at all and it is really a disastrous text book. Such a lot is omitted and such a lot of unnecessary questions are included.
The author's understanding of how a transistor behaves at the point of saturation is far from reality and gives the beginner a false understanding. The authors concepts are so bad I cannot begin to work them out.
All I can say is this: to get a transistor to saturate (when about 100mA collector-current is flowing), takes up to 10 times more current than you expect. This is because the gain of the transistor drops considerably when the current is above 1mA to 10mA. The gain-figures used in the examples apply to a collector current of 1mA to 10mA. In addition, to get the transistor to fully turn-ON, requires EVEN MORE BASE CURRENT. These facts

are not covered in the text book and that's why it is such a disaster.
Transistor DO NOT conform to tight tolerances like resistors. They are not 5% higher or lower when sorting through a batch. They are 50% lower and up to 200% higher. You cannot begin to put them into a stage that does not have any self-biasing features. The book is really a cruel joke for beginners.

Here's another fault: **transistors with the same part number have ß values within a narrow range of each other.**

Untrue. BC547A = 110 to 220
BC547B = 200 to 450
BC547C = 420 to 800
BC547 = 110 to 800

All these have a range of +100% The author's don't know what they are talking about.

Here's another mistake: For example, suppose a transistor has 500mA of collector current flowing, and you know it has a ß value of 100. Almost NO transistor has a ß value of 100 for 500mA collector-current. The gain drops to 25 when 500mA flows. The author's are out of touch with reality.

Here's another disaster: The value of ß will be almost the same for all measured values of collector-current. This demonstrates that ß is a constant for a transistor. **UNTRUE**.
The gain of a transistor reduces ENORMOUSLY as the collector-current increases. In most data sheets the gain of a transistor is given for 1mA to 10mA. These are totally misleading values. When the current increases to 100mA or more, the gain drops by 50% to 90%.

Here is the same mistake again: **It is a property of the transistor that the ratio of collector current to base current is constant.**

If you connect a capacitor and resistor in series (as shown in Figure 6.3), the circuit functions as a voltage divider. This may be so, but that's not the reason why a capacitor and resistor are connected in series. And we don't describe this as a "Voltage Divider:"

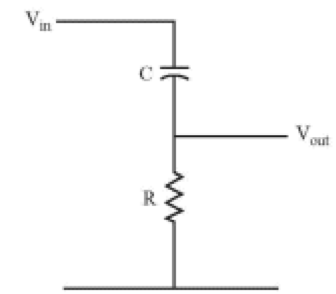


FIGURE 6.3

There are so many facts omitted from the text book. Take the following example. The book does not mention the fact that a coil and capacitor in parallel is called a **TANK CIRCUIT** and the waveform produced by the combination can produce a waveform that is 10 times larger than the supply voltage. It can be even higher (50 times).
Here is the absurd wording:
Because of the low DC resistance of the coil, the DC voltage at the collector is usually close to the supply voltage (Vs).
In addition, the AC output voltage positive peaks can exceed the DC level of the supply voltage. With large AC output, the positive peaks can actually reach 2Vs, as shown in Figure 9.10.
It is obvious the writers do not understand the capability of the circuit AT ALL.

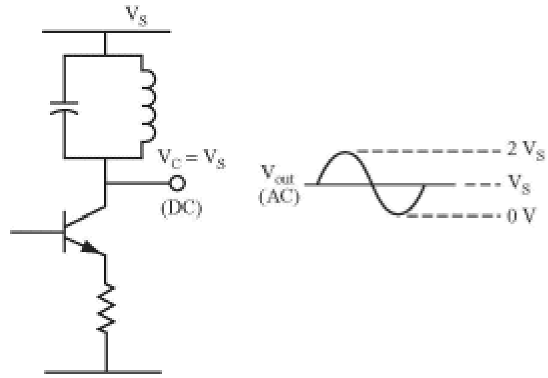


FIGURE 9.10

Here's an absurd sentence: **An inductor is a coil of wire, usually wound many times around a piece of soft iron. In some cases, the wire is wound around a non-conducting material.**
Does it mean magnetic NON-CONDUCTING or electrical NON-CONDUCTING ??

Let's look at this totally impractical circuit:

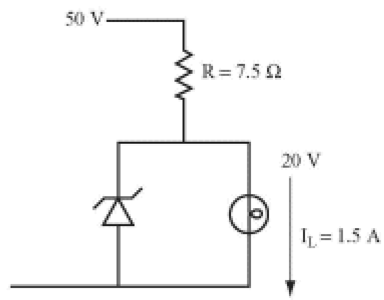


FIGURE 2.31

The zener must be able to handle the wattage is the globe burns out. If it burns out, the voltage across the zener will be 20v. The current through the 7R5 resistor will be 30v/7.5 = 4 amps.
The wattage of the zener must be 4 x 20 = 80 watts. The cost of an 80 watt zener is $???? 80 watt zener NOT AVAILABLE.!!! This is the sort of RUBBISH they are teaching beginners !!!!

The text book is analysing the following circuit to produce a voltage-divider.
In 40 years I have never used a resistor, capacitor and inductor to produce a voltage-divider.
I have never seen this type of circuit used as a voltage divider.
I don't know where he gets his ideas from.
It's no wonder a beginner will be confused. He is being taught things he will never use.

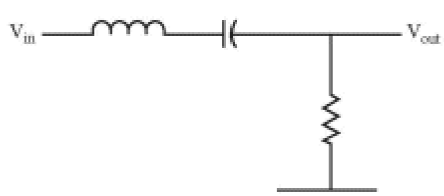


FIGURE 7.3

The **TANK CIRCUIT**

One of the most important concepts of electronics is the TANK CIRCUIT. This is because two simple components, a coil of wire - called an inductor - and a capacitor will produce a waveform (a sinewave) when a pulse of energy is delivered to the parallel combination. But that's not the amazing part. The amplitude of the sinewave can be LARGER than the applied voltage. In other words, the two components will AMPLIFY the pulse and produce a beautiful result.

When this was discovered, RADIO was born.
It is very complex to understand and the text-book does not describe it properly.

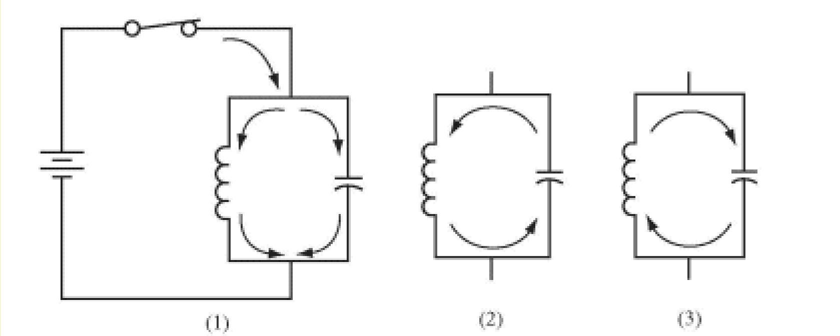


FIGURE 7.44

You need to understand how the circuit works because it does two things that are amazing.
Firstly it produces an output voltage that can be 10 times or **more than 50 times** larger than the applied voltage and secondly the output voltage will be **REVERSE POLARITY** to the applied voltage.

Firstly you need to supply a pulse of energy to the parallel combination. This is the first secret to describing how the circuit works. Don't keep the switch pressed for too long because the circuit only needs a very short pulse of energy.
When you deliver this pulse, the flow of energy into the inductor will produce magnetic flux and this will cut the turns of the coil to produce a back voltage (called a back emf) that will oppose the incoming voltage and only allow a small amount of energy to pass through the coil.
However the capacitor will be uncharged and it will readily accept all the rest of the pulse of energy.
The switch is now released and the capacitor will be fully charged and it does not matter if we have delivered too much energy to the coil or very little because the circuit will now start to operate.
The voltage on the capacitor will deliver energy to the coil and this will produce magnetic flux that cuts the turns of the coil to produce a back voltage. This will limit the flow of energy from the capacitor to the coil and it will take time (maybe only a few milliseconds or microseconds) for the energy to pass from the capacitor to the coil. When all or nearly all the energy has passed, the magnetic flux can no-longer be maintained and it starts to collapse. This collapsing magnetic flux cuts the turns of the coil in the opposite direction and produces a voltage in the turns that is opposite to the supplying voltage. This voltage charges the capacitor in the opposite direction.
And the amazing part is the voltage can be higher than the original voltage.
When all the flux has been converted to electricity, the capacitor begins to send the charge to the coil and although the voltage is in the opposite direction, it produces expanding flux and the cycle begins again.
During the cycle, some of the energy will be lost in the magnetic flux and the following waveforms will be reduced. That's why a small pulse of energy must be delivered to the circuit to maintain its operation.

These important points are completely missing from the text book and without an explanation like this, the beginner gets a false understanding of how the **TANK CIRCUIT** works.

There are many more faults with the text-book and apart from the fact that emitter-follower stage is very poorly presented, the main problem with the book is the lack of simple detail, explaining WHY a circuit is chosen for a particular application. The author never mentions the output current of an emitter-follower stage is 100 times (or ß - the gain of the transistor) the current entering the base. He only talks about the voltage gain of "1."
There are a lot more stupid comments to falsely steer the beginner and it's a waste of my time going over any more of the pages as the book should be "shelved."
The book is not worth buying as you can get everything by Googling the web.
In fact, you can get a much better explanation and by visiting a number of educational sites, you will avoid the faults in the text-book.
I add this to my long list of text books that should be taken off the shelves.

As you would expect, no reply from Wiley, the publishers of the book: info@wiley.com
A "plastic" reply from Earl Boysen, one of the authors of the book: earl@buildinggadgets.com

Hello Colin,

Thanks for the feedback, I'll review your comments for the next revision of the book and appreciate you taking the time contact me.

Earl Boysen

After 2 weeks I received a reply from Wiley:

Thank you again for your errata for the above book. I have been corresponding with the revising author and we will incorporate a few of your suggestions. **(A FEW OF YOUR SUGGESTIONS!!!!)**

You are certainly entitled to your opinions and we respect them. However, we do feel that disagreements among professionals in many professions occur and we would like to think such disagreements are handled with the utmost respect for all parties involved.

Regards,

Carol.

Harry Kybett has died.
I know no-one likes to be criticised, but when you are taking a huge amount of money - $34.00 ($17.00 for a second-hand copy) for a few pieces of paper, you have to take responsibility for delivering something of value. It's fortunate you can download nearly every book on the web **at no cost** to see the content. Even so, far too many people are buying books, sight unseen, and regretting their purchase. You can see second-hand copies for 1/10 the price and this is an indication of the worthlessness of the book.

Before we go, here are more than 10 absurdities, that show the complete lack of understanding of electronics, of both authors:

The op-amp suggested in the text is OPA134. Cost $3.50 Why not use a simple, cheap op-amp?
The text claims the collector voltage of a TURNED-ON transistor is 0v. This is UNTRUE.
The text-book uses too many "non-standard" value components. Values I have never heard-of and never used. This is not the way to educate the beginner.
The text-book describes too many circuits that are not practical and have never been used in practice. Biasing the base with two resistors and a three transistor DC coupled circuit are two examples.
The book never covers capacitor values as "n" For instance 100n is 0.1u All ceramic capacitors are identified as 102, 103, 104.
Many questions are difficult to answer. For instance: "What makes an amplifier into an oscillator"
Answer: "A resonant LC circuit with feedback of the correct phase and amount." There are many more answers. It does not need an LC circuit. It just needs POSITIVE FEEDBACK.
The text book constantly says the reactance of a capacitor should be 1/10 the resistance of the parallel resistor but does not explain WHY!!! That's the purpose of a text book.
Many sentences are badly worded. For instance: "Both transformer coils are usually wound around a core made of a magnetic material such as iron or ferrite to increase the strength of the magnetic field."
A magnetic core **allows** a higher flux density (than air) to flow around the path called the MAGNETIC PATH. The magnetic material **does not increase** the strength of the magnetic field, it just allows a higher density flux to flow though the magnetic path.
Figure 2.32 has the incorrect current-value for the lamp and/or I don't understand the question.
The text-book specifies a 1N4735A zener? Why not just specify the zener voltage? We are not trying to sell zeners !!
Here is one of the sentences I do not agree with: "You can consider the diode to be a perfect diode and thus assume the voltage across it is 0 volts."
A PERFECT DIODE will have 0.7v across it. A faulty diode will have 0v across it !!!
He then goes on to say that 0.7v is dropped across a diode when the current is 100mA or 1Amp !! In actual fact the voltage increases to about 1.1v when the current increases and that's why the diode gets hotter and hotter as the current increases.
A globe is included in some examples. This is a very bad example as a cold globe has a resistance of 1/6th the hot resistance and many of the circuits SIMPLY WILL NOT WORK.
The battery symbol is drawn with the negative at the top.
The equations contain mixed units: V_R = 1 kΩ x 10 mA = 10 volts and MΩ and kΩ for resistance. He also suggests absurd values for electrolytics such as 230u or 265u and working out the final voltage as 39.59v when the data is only accurate to whole numbers (40v), and pi filters using resistors.
All these things show a total lack of understanding of teaching, especially to beginners.

You have to take a broad-look at the content of the book to see how many of the pages are unsuitable for a beginner and quite irrelevant to the understanding of how a particular building-block works. No mention is made of the self-biased transistor stage and the two simple stages mentioned in the book are a disaster to bias. The book goes into far too much detail with oscillators using inductors and fails to include the "phase-shift oscillator"

and multivibrator, the two most popular oscillators and the easiest and cheapest to design.
That's why I am so critical of the book. If you are going to charge for something, make sure it cannot be criticised.
To say: **Complete Electronics Self-Teaching Guide with Projects** is a complete overstatement. Hardly a project to be seen and nothing about the self-biased transistor, multivibrator or Phase-shift Oscillator - two of the most important - fundamental - building blocks.

We will see what corrections have been done. You can get all the same content on the web AT NO COST. The content is by-far a compete course and it leaves out some very important building blocks.
I was horrified by the reply: "We will incorporate **a few** of your suggestions."
It took Wiley and Boysen **TWO EMAILS** to get them to reply and they only replied because of my website and the possible exposure I created.
Overall the book is not worth buying and you can see a BASIC COURSE in ELECTRONICS on our website.

Here's another stupid project from **Electronics For You** (September 2013 issue) by D. Mohankumar**:**

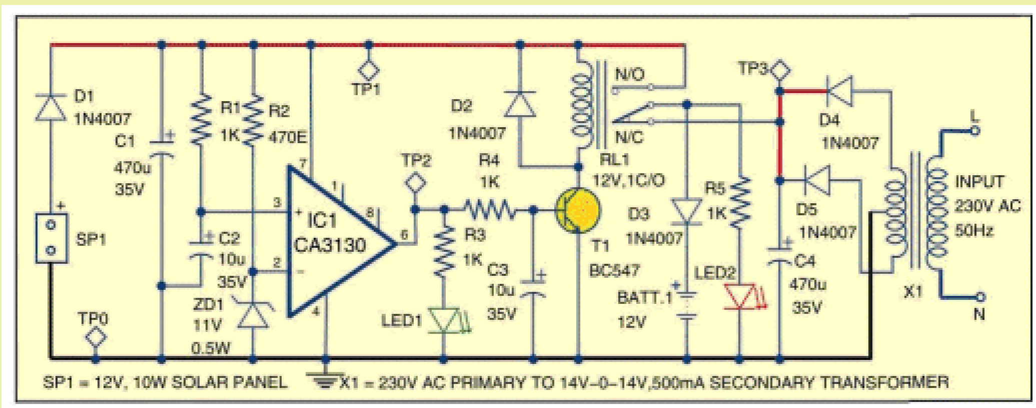


Fig. 2: Hybrid solar charger circuit

You can always bet he will come up with a worthless circuit, filled with mistakes.
Firstly, you don't need the op-amp. The circuit below turns ON the transistor when the solar panel reaches 11.6v
You don't need D3 and some of the other components.
You can't connect a 14v transformer to a 12v battery without a current-limiting resistor. The transformer will BURN OUT. Resistor Rx (10R) is needed to match the two components. I have told both Mohankumar and EFY about this mistake for the past 12 months but the Technical Editor of EFY **Sani Theo** has failed to reply and failed to check or test any of the projects submitted by D. Mohankumar. How can you possibly expect the Indian electronics beginner to succeed when the major electronics magazine in India is so inept.

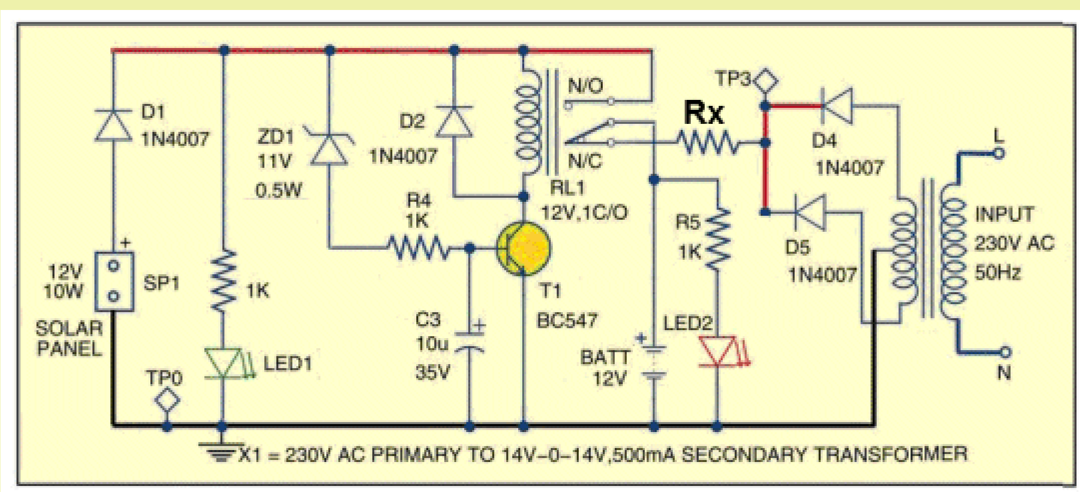


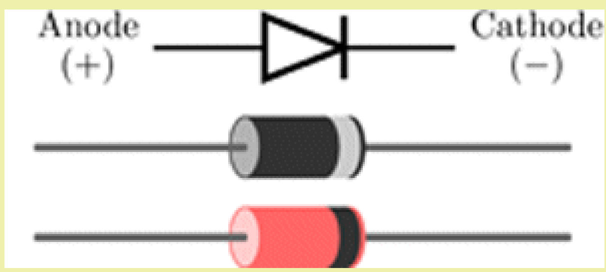
Fig. 2: Hybrid solar charger circuit

D. Mohankumar must have finally read some of my comments as this is his comment on his site:
One of my readers makes very harsh criticism about my circuits. **That's me**
His main hobby is to snap shot my circuit and publishing the same in his website with abusing comments. **The comments have been made after emailing D. Mohankumar**

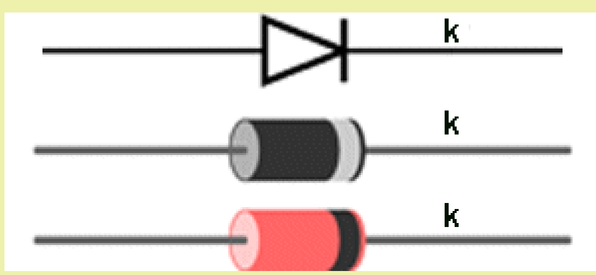
with NO REPLY. The circuits DO NOT WORK.
He also post such comments in my blog but I am not moderating the same because the language is not suitable for a public site.
He is not testing the circuits before making comment like “will not work”, “don’t do this”, “hazardous design” “poor design”, “rubbish circuit” “disaster” etc. **How do you know I am not testing the circuits ???????**
I don’t know how one can confirm the working of the circuit without testing. He claims that he can confirm the working through visual observation only. **That's the DIFFERENCE between him and me. I am a PROFESSIONAL . I don't put STUPID circuits on the web.**
Really, a magic that cannot be done by any experts in electronics. **That's where you are WONG. How do you think I have designed circuits for the past 40 years?? I can see them working in my mind and then put them together. He should go to an electronics expert before he makes such STUPID comments. He is making a FOOL of himself.**
Here's a comment from another electronics site: **One of the most useful skills in electronics is that of looking at a circuit diagram and understanding how the circuit works.**
You can **"see"** aa circuit working if you understand the principles of electronics. D. Mohankumar doesn't understand the basics so he will never be able to see a circuit working.

7,000 visitors read Talking Electronics site each day and anyone can send me an email.

D. Mohankumar hasn't bothered to correct the RUBBISH on his site.
He keeps putting silly things on his website:



All diodes are zener diodes. The picture above is a diode. What does the (+) and (-) mean? Only the cathode (k) lead is marked. The actual placement in a circuit will depend on the type of diode, its function and if the cathode is connected to the 0v rail. Sometimes the anode is connected to the 0v rail. That's why only the "k" lead is identified.



Capacitor	Voltage	Current
334K	10	22 mA
104K	4	8 mA
474K	12	25 mA
105K	24V	40 mA
225K	24V	100mA
684K	18V	100 mA

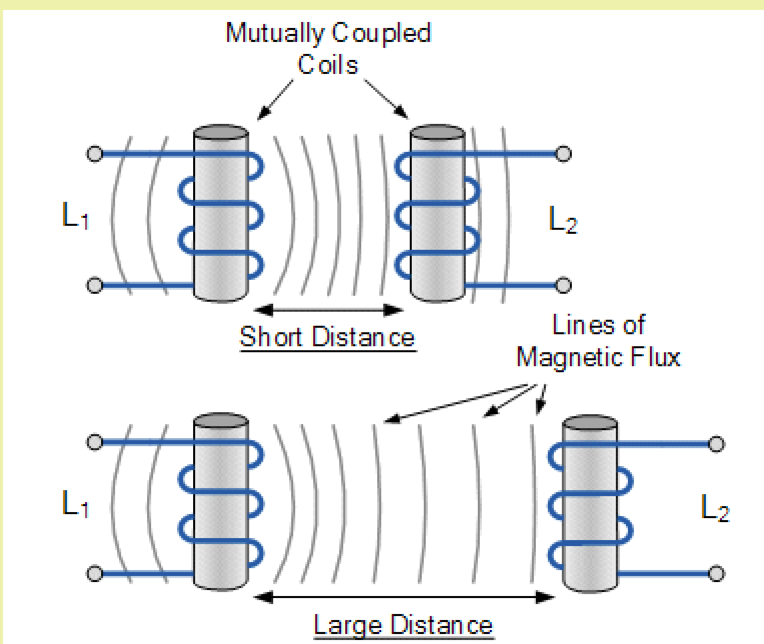
If 334 produces a current of 22mA how can 684 produce a current of 100mA ?? None of the values above make any sense.

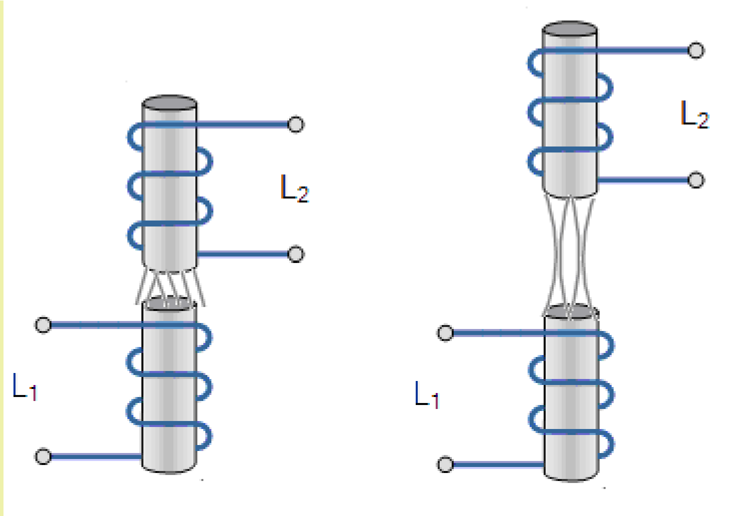
In his Capacitor-fed Power Supply, he gets mixed up with voltage and current. He doesn't understand that a Capacitor-fed Power Supply is a CURRENT DRIVEN supply. The output voltage depends on the LOAD.
Any capacitor on the front-end can produce a supply from 1v to about 300v. **That's why they are so dangerous.**

He says silly things like: But the limiting resistor R is important, without which the Zener diode will be destroyed.

The capacitors on the front-end are LIMITING THE CURRENT - not the resistor in series with the zener. The zener WILL NOT BE DESTROYED.
The volt-dropping resistor (not CURRENT-LIMITING) is designed to allow the electrolytic to remove the ripple.
A capacitor-fed power supply is COMPLETELY DIFFERENT to an ordinary supply and he is confusing the two.
He uses a 4 amp fuse to protect 100mA Power Supply !! That's why he knows **NOTHING ABOUT ELECTRONICS**. That's why he should **GET OFF THE WEB**.
If you read an article by Professor D. Mohankumar on **Dog Breeding** where he said Pekinese "grow ears out of their mouth, " you would immediately realise he doesn't know what he is talking about. The same with electronics. Just one stupid statement and he should be banned from the web. He is hiding behind his stupidity by not displaying my comments on his website. I have already sent more than 20 comments and NOT ONE has been displayed.
It's no good "crying on your website" about being treated unfairly when you have completely abused your responsibility by repeatedly producing false and misleading information, AFTER reading this article, and being told of the mistakes.
It's hard enough to learn electronics without some IDIOT coming along and delivering faulty material.
It's a pity no-one else is correcting theses websites but, as I said, it takes a lot of understanding to realise they contain faults.
I have criticised over a dozen writers, authors, "electronics professionals" "electronics professors" and NONE have written to me to say I am wrong. In most cases they have not even had the decency to fix the mistake.
I have over 4,200,000 visitors in the past 2 years and none have said I am wrong.
Very few people understand the basics of electronics. They can calculate the impedance from a formulae and do other wondrous, complex things, yet fail to understand the difference between an ordinary power supply and a capacitor-fed supply.
I am here to teach the BASICS. You can get the advanced theory from a book. It's the basics that is never explained correctly or skimmed-over because the explanation is very hard to put into words.
Show me an explanation of the Phase-shift Oscillator - without the non-sensical approach of saying it consists of three 60° phase-shifts. We know it must have a total of 180° phase-shift, but HOW DOES THE CIRCUIT WORK? Most books glide over the real explanation and when you test a circuit and find negative on a capacitor, you get a surprise.

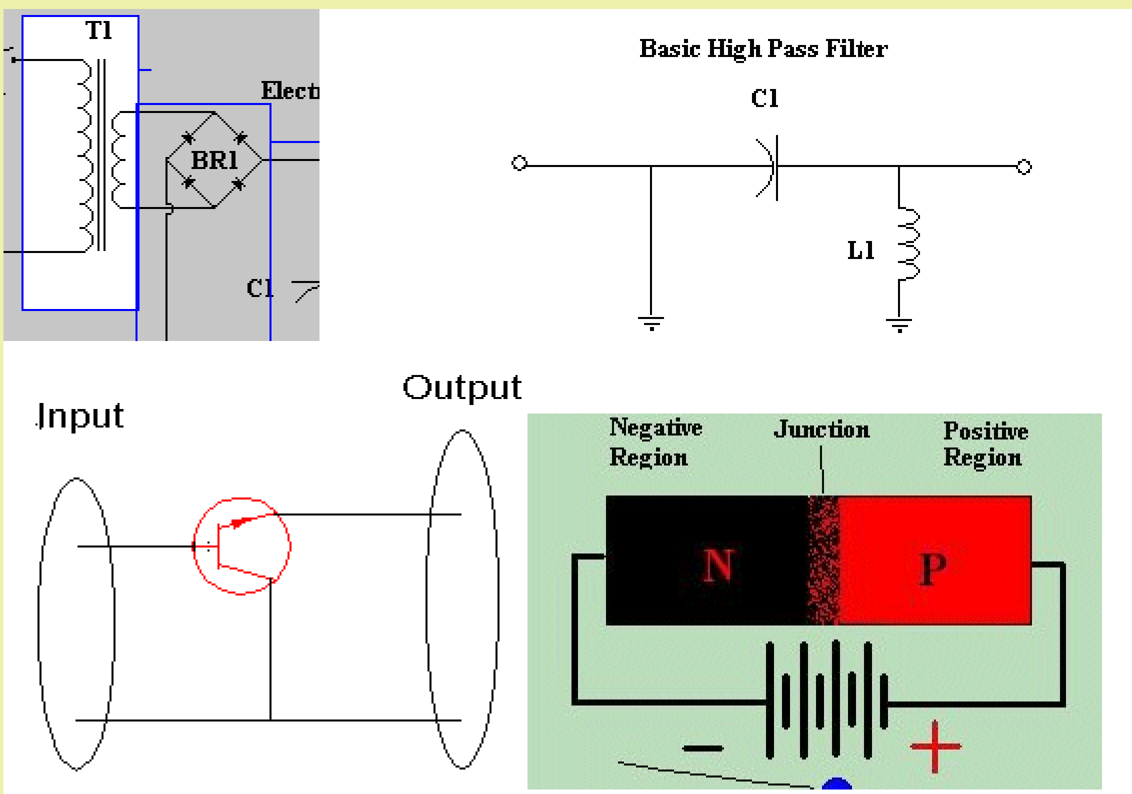
Here is a slight correction to a very good tutorial on Inductance at:::
http://www.electronics-tutorials.ws/inductor/inductance.html



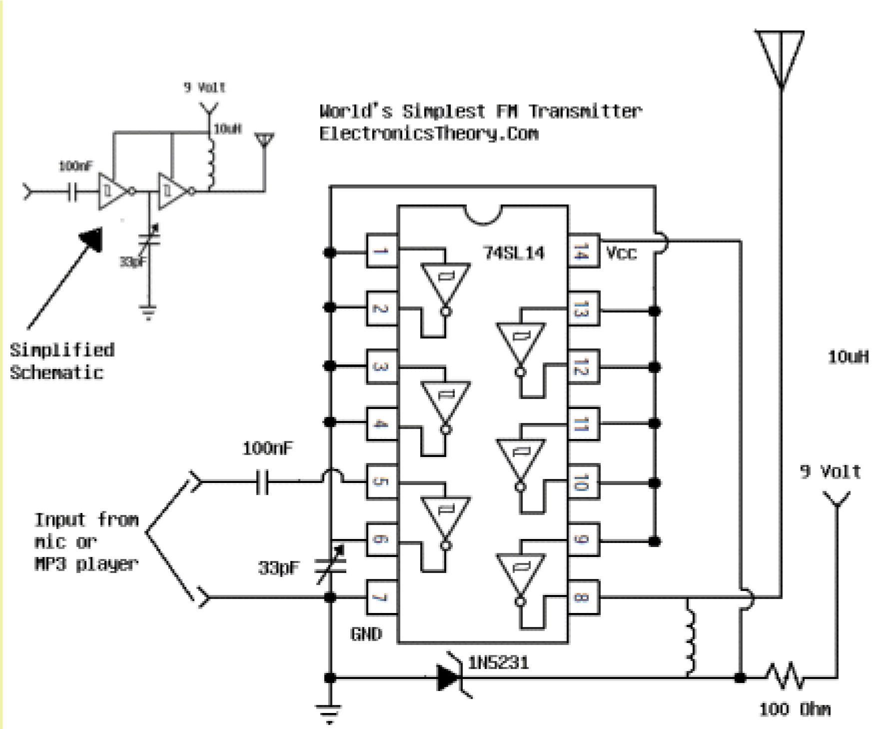


The coils should be placed in alignment as the magnetic flux extends out the ends of the coil and very little is produced along the sides. Placing the coils side-by-side gives the beginner the wrong impression on how coils are mutually coupled.
I mentioned this to: Wayne Storr
webmaster@electronics-tutorials.ws
but no change has been made on the website.
It's small things like this that give the wrong impression and make it hard for the beginner to learn.

Here is another **Basic Electronics** website that is filled with mistakes.
Electronicstheory.com

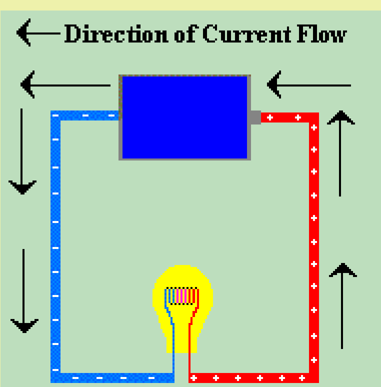


Two diodes are around the wrong way. The input of the High Pass Filter is shorted to ground.
The PNP transistor is connected incorrectly. The battery symbols are incorrect.



The inputs to the Schmitt Trigger gates are connected to the outputs.
This will make the gates oscillate at 100MHz for this chip as it is a very high speed chip.
Here is the reply from Mr Ray Dall: **That part of the circuit is not in use, but I wouldn't expect you to see, much less understand that.**

The text also has numerous mistakes.
For example, he states CURRENT flows from NEGATIVE to POSITIVE.
This is the direction of ELECTRON FLOW.
Current Flow is called CONVENTIONAL CURRENT and flows from POSITIVE TO NEGATIVE.
If we don't have a common way to describe current-flow, how are we going to use Flemings Left and Right Hand Rules????



He also states:
Pin 5 of the 555 sets a "control voltage (typically .6 to .7 volts - typical e-b junction biasing for a silicon transistor). When pin 6 rises ABOVE the voltage at pin 5, the timing interval ends. **WHAT RUBBISH** !!!!!!
He also describes the Multivibrator incorrectly and other things.

The site is written by:
Ray Dall BSEE
Radio Frequency Engineer
comments@electronicstheory.com

I emailed some comments and got this reply: **If I get any more emails from you they will be summarily deleted**.

How can an "electronics engineer" make so many basic electronics mistakes, refuse to identify them, reply with a number of rude emails, then want to "hide under the table."

Next we have Greg's Basic Electronics who is trying to flog his Basic Electronics course for $37.00.

It might be worth $37.00 if it doesn't contain any of mistakes on his web page and in his preview eBooks. Here are some of his interpretations of electronics:

1 - 100k linear taper pot.
How can you get "linear taper." It's log taper or antilog taper or LINEAR.
He states a chip has Vcc and Vcc-
How can you get Vcc- ????
He states capacitors are measured in microfarads and picofarads and forgets nanofarads.
This is because he is from the radio days and not up-to-date with modern electronics.
Don't try driving a large load like big stereo speakers with the LM386. It works great for small

Here's Greg Carpenter

speakers.
What does he mean by this?
Some values to try are .05uF for C1 and C2 as well as 18k for the LM386. That will make a lower pitched note.
What does he mean by this?
When current flows through an inductor a magnetic is formed around the inductor. When the current stops the field collapses back. Also, if you take a magnet and pass it around a coil a current will be induced in that coil or inductor.
What terrible English-Expression. I know what he is trying to say but a beginner will get the wrong interpretation.
He is also recommending eBooks by Jestine Yong and these are filled with poor grammar and its almost impossible to work out what is being taught.
All the data in these eBooks is readily available on the web for FREE and it's pointless spending money on poorly written technical material.

Professor **D.Mohankumar** is still coming up with RUBBISH articles. Here is his latest disaster.
He claims an 800 VA inverter with 126 Ah battery can power 500 watts load for 3 hours.
To deliver 500 watts requires very close to 50 amps. He claims the battery voltage is 14.8v when fully charged.
The 14.8v is called a "floating charge" and is the "back voltage" produced by the battery when it is fully charged.
But as soon as you draw a current, the voltage immediately drops to 12.6v and possibly a little lower when 50 amps is delivered.
Inverters are not 100% efficient and that's why you can safely allow 50 amps for a 500 watt load.
At 50 amps you are drawing current on a "2.5 hour basis" and a 126Ahr battery is rated at 126AHr when current is drawn over a period of 14 hours. At 50amps you will get less than 100AHr. But at 50 amps the voltage of the battery will drop to 10v after about 1 hour so the inverter will drop out after 60 minutes and NOT 3 hours.

More RUBBISH from Professor **D.Mohankumar**:

Ohms Law and Resistance

Value of Resistance = Volt in Resistor / Current in Resistor

R = V / A Eg. 12 V / 0.02 A = 600 R(Ohms)

As Voltage increases, Current also increases

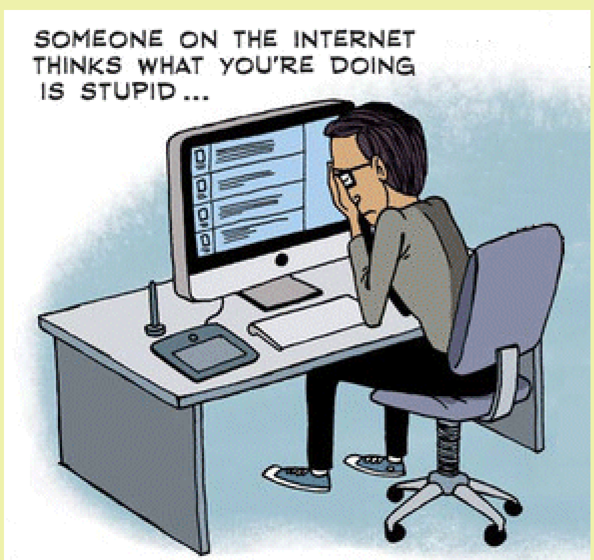
Value of Resistor = Volt meter reading / Current meter reading

12V / 0.1A = 120 K

Current = V / R = 6V 100R = 0.06 A Or 60 mA

¼ Watt	Max. 50mA
½ Watt	Max. 70mA
1 Watt	Max. 100mA
2 Watt	Max. 140mA
20 Watt	Max.440mA

12v / 0.1A = 120 ohms NOT 120k
1/4watt resistors will accept up to about 500mA if the resistor is 1 ohm or 150mA if the resistor is 10 ohm. Or 125mA if the resistor is 15 ohm and 105mA if the resistor is 22 ohm.
The current depends on the resistance of the resistor.
Use the formula: Wattage of resistor = ($I_{Current}$ x $I_{Current}$ / Resistance of resistor

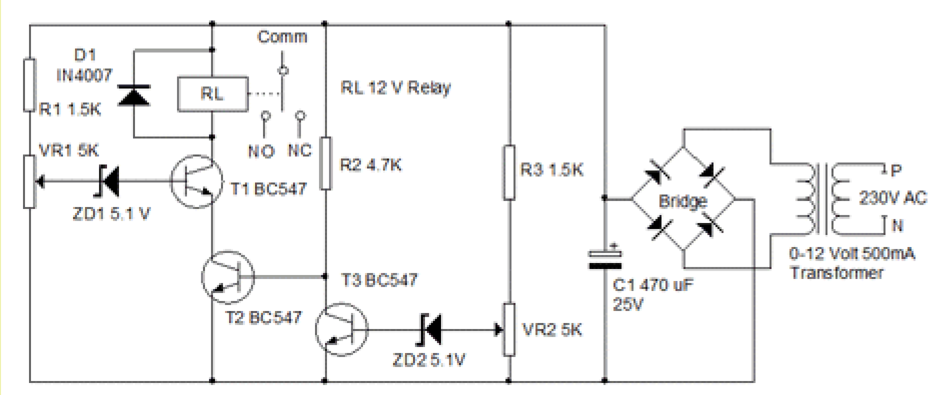


Professor **D.Mohankumar** keeps adding to his website with articles containing dozens of mistakes. He still does not listen and refuses to correct his articles.

What does this mean: Zener diode requires a series resistor to limit current across it

What does this mean: Instead of the Zener, we can use a 7805 voltage regulator which is more reliable.

This is another of Professor **D.Mohankumars** stupid circuits:



The second zener and the BRIDGE is around the wrong way.
When the voltage rises, the first transistor turns ON and the third transistor turns ON. This turns OFF the middle transistor and the first transistor does NOTHING. What is supposed to happen??

Where does he get this RUBBISH from:

The forward voltage drop range in Blue and White it will go up to 5 volts.

LED current minimum 20 mA is required to get sufficient brightness.

Don’t use White or Blue LED as indicators. They consume 3 volts from the circuit and the light is not healthy for the eyes.

In battery operated devices, it is better to avoid LED to conserve power.

LED is a polarized device so it should be connected in the correct polarity. The long lead is positive.

The resistor is called a ”Ballast Resistor” which protects LED from damage due to excess current.

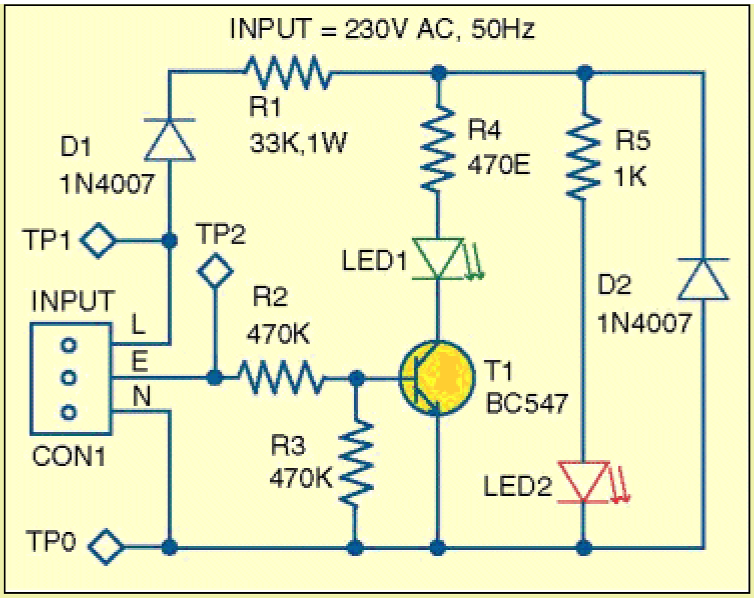
It is measured in terms of lumen per watt (lm w).

When will he get off the web ??????

Look what this IDIOT is putting in **ELECTRONICS FOR YOU** Magazine October 2013.
Sani Theo, the Technical Editor doesn't check ANYTHING:

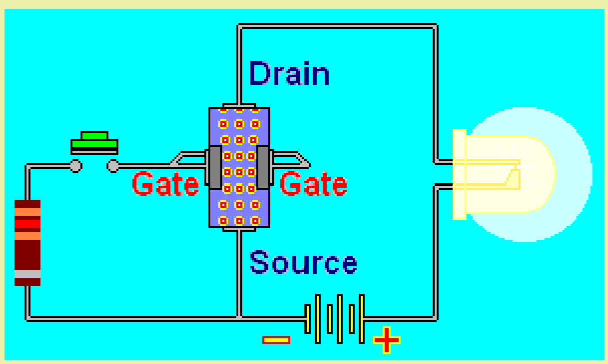
When the mains wiring is proper, a potential difference develops between the neutral (N) and earth (E) lines and transistor T1 turns ON to light up the green LED (LED1). This indicates that the earth connection is perfect.

WHAT RUBBISH !! There should be NO voltage developed between the Earth and Neutral.
The Active and Neutral enter a property via either two separate wires or a screened wire with the ACTIVE in the middle and the NEUTRAL wound around the outside.
These two wires go back to a transformer down the road where the 240v is produced by a transformer. As we know, the secondary of a transformer is not connected to any other wiring and so one of the leads is connected to a wire that runs down the lamp-post to a spike driven into the ground.
This wire becomes the NEUTRAL as it will not have any voltage on it.
The other wire is called the ACTIVE and these two wires go to each home.
At the meter-box, these two wires are connected to each outlet as ACTIVE and NEUTRAL.
But suppose the spike at the lamp-post gets broken.
The two wires will now be "floating" and if you touch the Neutral, you will get a tingle.
For instance, if you have a toaster and the heating element is connected to Active and Neutral, and the metal frame is not connected to anything, you will get a slight tingle if the heating element has a slight leakage to the frame.
This is because all the voltages are "up in the air."
Now we introduce a SAFETY wire. It is called EARTH.
At the front of the house we hammer a long spike into the ground and connect a green lead.
We take this green lead to the earth pin of all the outlets.
This wire is connected to the frame of all appliances.
Now, it does not matter if the Active and Neutral are "up in the air" because the frame of the toaster is SAFE to touch.
But the Active and Neutral are NOT UP IN THE AIR. The neural is connected to the ground via a spike at the lamp-post and if not **CALL THE ELECTRICAL SUPPLY**.
I have written this so that even **PROFESSOR D.Mohankumar** can understand how the supply to your house is generated.

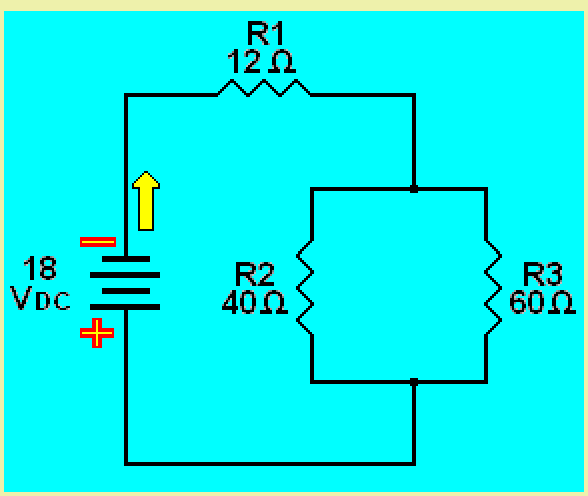


What is D2 doing? When the Active reverses, D1 prevents and current-flow so D2 is not needed.
R4 is not needed as the green LED only turns ON when the earth generates a fault. The red LED should be green. The green LED should be red.

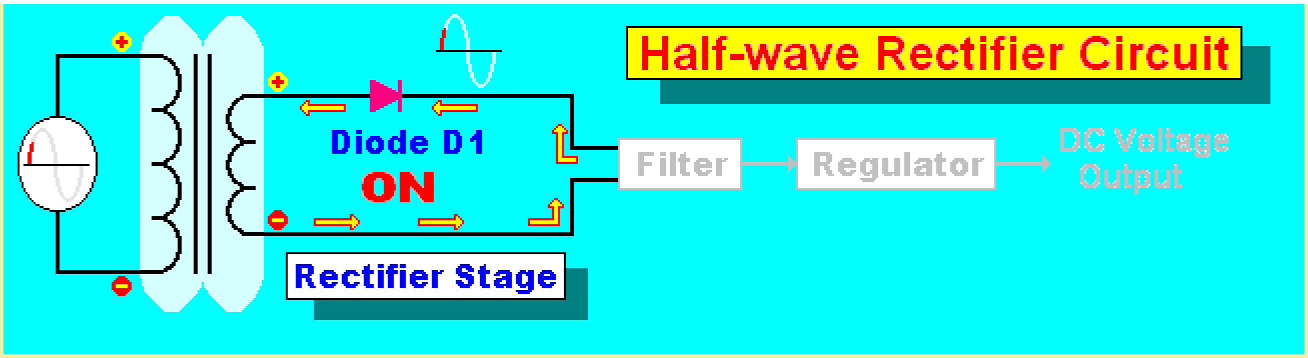
Here's some RUBBISH from Electronic Supply Co. They are trying to sell a Basic Electronics Course for $250.00 and their website is filled with mistakes. Here are a few:



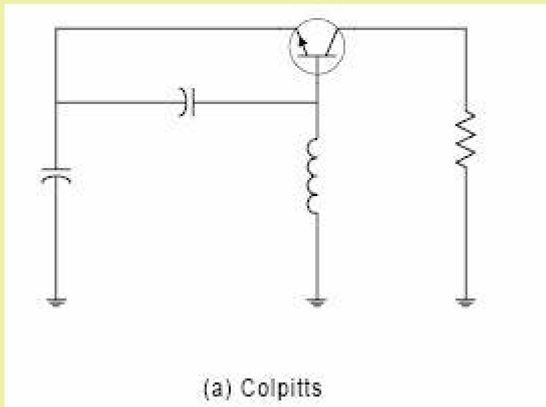
A FET does not turn ON when the gate is "floating"



The arrow is going around the wrong way



The arrows are going around the wrong way. The circuit is flickering too fast to see what is happening.

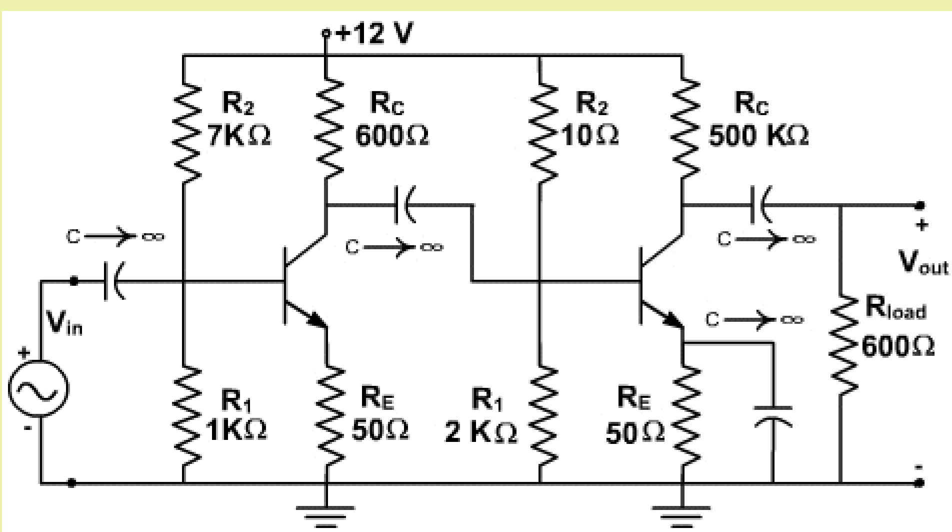


The emitter is not connected to 0v. The circuit will never work.

How can you possibly expect to learn anything from a website that has basic faults in their promotional material.?

Here's some more RUBBISH from an Indian University website:
http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-ROORKEE/BASIC-ELECTRONICS/

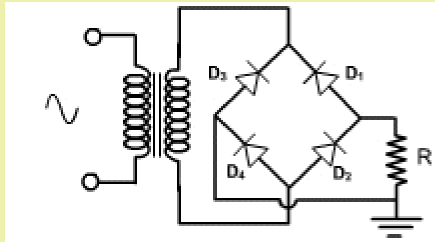
Lecture 24 Cascade Amplifiers:



The base has 10 ohms. The biasing of the second stage will result in the base voltage being 11.9v How do you expect the transistor to have any amplitude????
On top of that, the value of Rc (500k) will produce NO output as the output is provided by the value of the LOAD resistor. This is something we discussed in **The Transistor Amplifier** article and have never been mentioned in any text book. **Prof. Pramod Agarwal** does not understand what he is doing. How do you expect the students to understand?
Obviously the base resistor should be 10k and the output 500 ohms. But no student has picked up the mistake in 6 years!! I wonder how much they are learning !!!!!

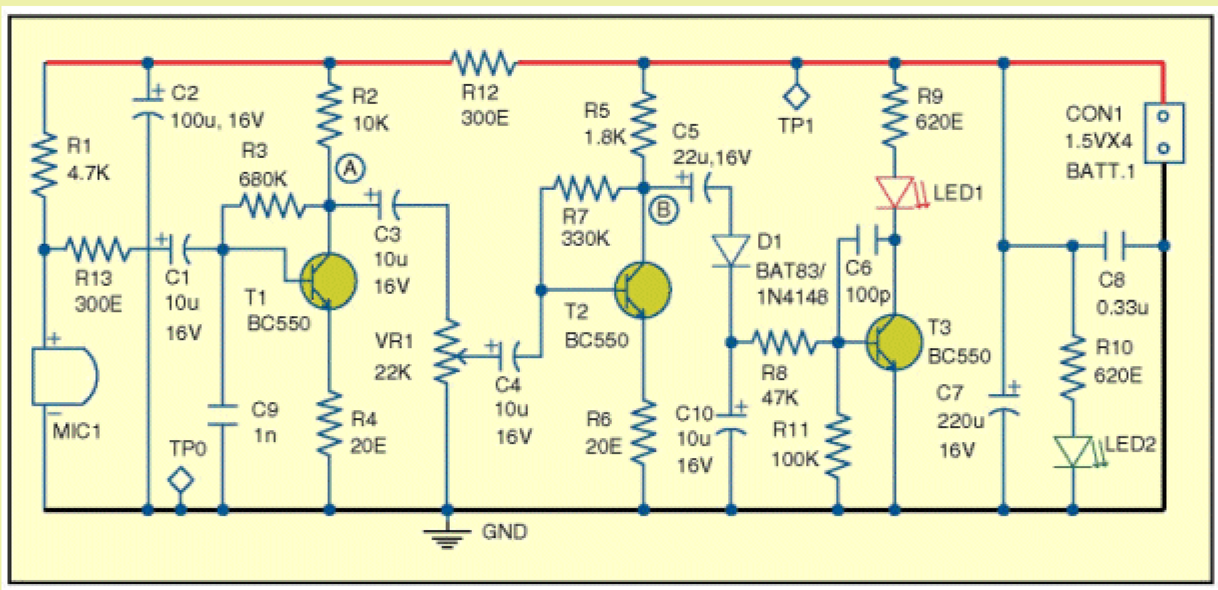
I noticed the mistake IMMEDIATELY because each resistor in a circuit has a range of values that will be acceptable. If they are outside this range, you need to look at the circuit and find out WHY?

Here is a bridge rectifier from his website:



He doesn't even have the understanding to look at the diodes and make sure they are all facing towards the positive output.

Here's another project from **Electronics For You** (October 2013 issue) **with mistakes:**



Apart from the fact that the circuit is far too complex, the 10u (C10) can be charged via diode D1 and electrolytic C5. But when transistor T2 turns ON and lowers the voltage on the collector, the 22u drops and D1 is reverse biased and C5 is not discharged. This means C5 gradually charges and never discharges. The circuit will never charge C10 and thus the circuit will not work.

Just another untested RUBBISH circuit presented by Sani Theo (the technical editor) of **Electronics For You.**

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SPOT
THE MISTAKES!

Page 19

Statistics are an amazing thing.
I didn't believe in statistics, but when I added "statistics" to my website I realised how accurate the data can be.
Traffic to the website has gradually increased to 6,000 new visitors per day and the download has been 600,000 images per day.
But the amazing thing is: The readership of various pages has been absolutely static for months. We get 225 visitors each day to "50 - 555 Circuits" and 4,500 downloads of the .pdf each month.
While the figures remain constant, the "fall-off" of the printed word has been enormous.
Magazines and publications are not letting you know, but the purchase of the physical magazine is falling rapidly. Readers are downloading the issues from download-sites rather than taking a subscription and it looks like magazines will go the same way as newspapers.
Apart from requiring less resources, reading on the web is more convenient and more "instantaneous."
You can easily print-out anything you need and store the rest without having to take up shelf-space.
Not only that. You can update an article, add corrections and include readers comments. It's a much-more personalised approach and you can add colour photos at no extra cost.

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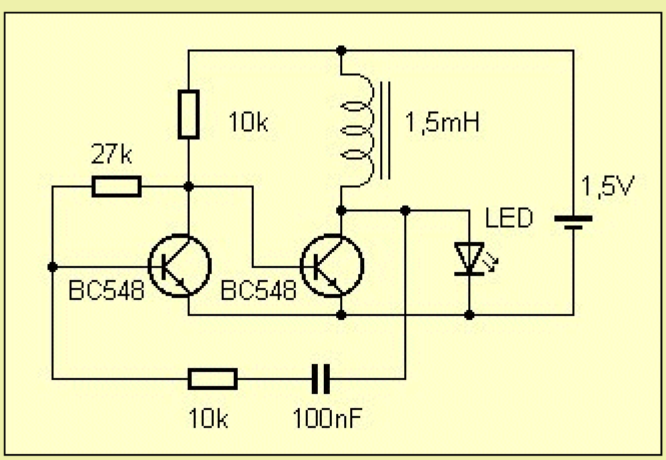
There are many websites, eBooks and publications on BASIC ELECTRONICS and I am not going to compete with the information already provided.
That's why I have concentrated on explaining how a fault can develop in a circuit and how to avoid designing a faulty circuit.

These comments will help both the newcomer as well as the advanced designer as mistakes have been found EVERYWHERE.
As you know, I fixed TV's and electronic equipment for 20 years and they were riddled with faults. That's why we were so busy.
Faulty equipment is becoming rare and most devices are thrown out the first time they fail.
However it is important to know how to design circuits and diagnose them as you don't want to get fired due to a whole batch of products being recalled due to a fault in your design. And secondly you don't want to be shown-up when you fail to analyse a problem.
Test equipment and simulation software is not always the answer. These aids are very helpful but you still need to know how to rectify the problem.
It's through all these faulty circuits that you get a background of "what can happen" and "where."
You never know when a fault we have covered will lead you to solving a problem of your own.
There is so much knowledge on our website that it will take you months to cover all the information. That's why we have an index on the front of the site and a CD containing all the 200MB.
This gives you a few choices.
You can buy the CD for $10.00 and load it into a USB stick so you can take it anywhere or read each article on the site and go through the whole index.
Some of our comments and ideas have never been covered before in any text book because most of the writers have never built a circuit in their entire life!
It's a bit like Marco Polo never mentioning chop sticks. Because it is doubtful he actually never went to China.

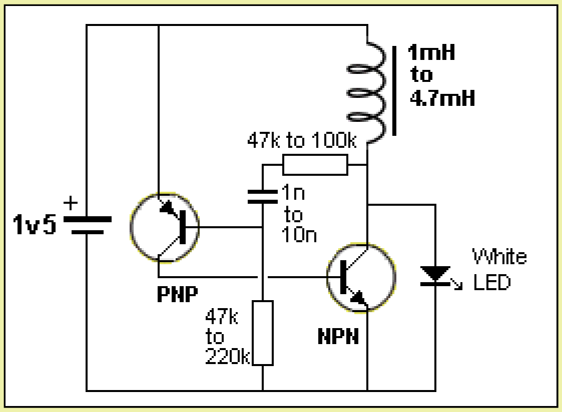
WHITE LED DRIVER CIRCUIT - POOR DESIGN



This circuit seems to have all the qualifications to illuminate a white LED, but it is a **very poor design**.
In the following two designs, the transistor or transistors are being turned ON by increasing current into the base of the driving transistor and when this transistor is not turned on, the current is a minimum.
Base-current is effectively wasted current or "wasted energy" and it is kept to a minimum.

In the circuit above, the base current is constant and will be very small through a 10k resistor. The circuit consumes 10mA and the LED will see less than 4mA.
By reducing the 10k base bias resistor to 470R the circuit current increases to 25mA but the LED is still not at full brightness.
Secondly, the base-current is shorted to the 0v rail via the first transistor and is completely wasted during part of the cycle.
But the main problem with the circuit is the fact that the driver transistor is not driven into full conduction at any part of the cycle and the circuit has very little efficiency.

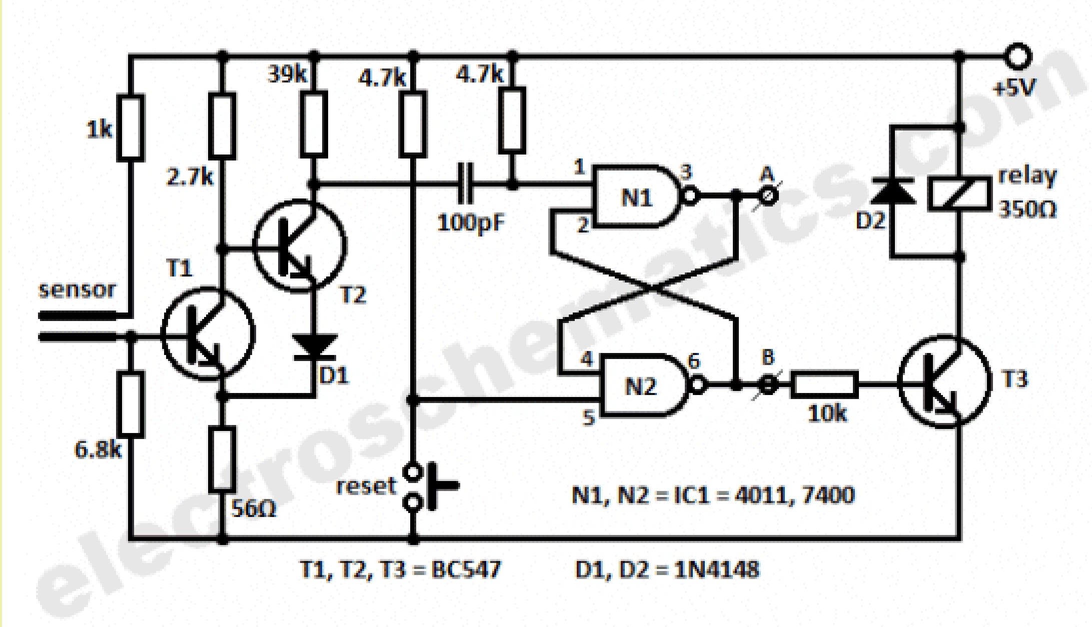
An improved circuit is shown in the following diagram:



2-Transistor Joule Thief Circuit

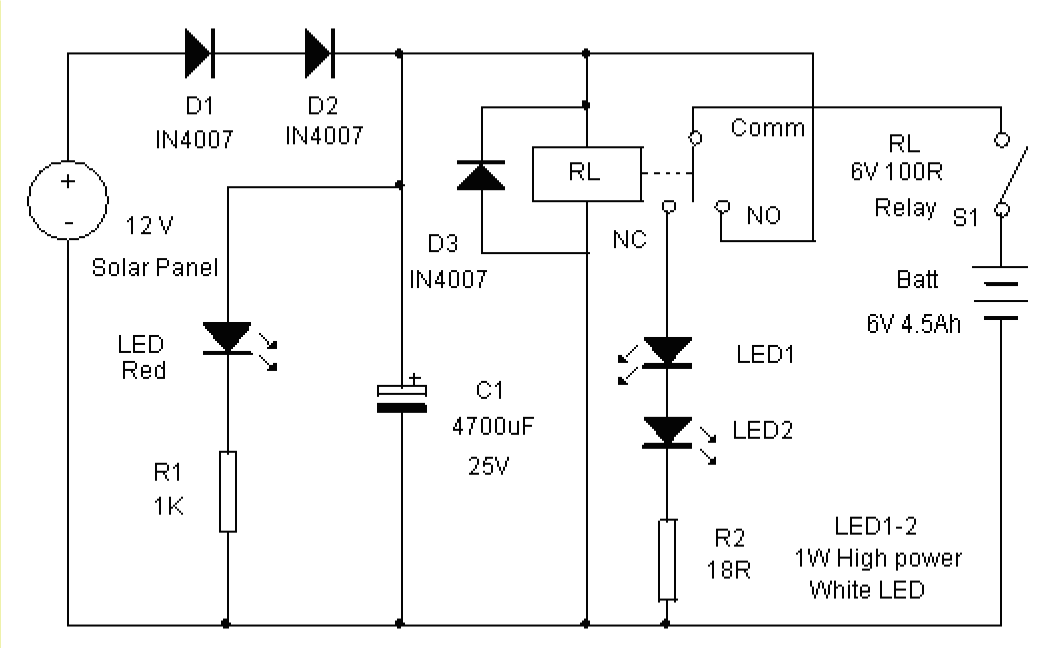
The circuit turns ON via the 220k resistor and the voltage on the collector of the NPN transistor drops to nearly 0v. This action causes current to flow through the inductor and at the same time the 1n capacitor is brought towards the 0v rail and this turns ON the first transistor slightly harder. This action continues until the driver transistor cannot be turned on any more.
The 1n charges a little more and the current through the base lead reduces slightly. This action turns OFF the first transistor slightly and the driver transistor is turned OFF a slight amount.
The voltage on the 1n rises and very soon both transistors are fully turned OFF.
The magnetic flux in the core of the 1mH inductor collapses and produces a voltage in the opposite direction.
This voltage is added to the 1.5v rail voltage and the final voltage is high enough to illuminate the white LED.
This keeps both transistors OFF and when all the magnetic flux has been converted to energy to illuminate the LED, the voltage on the collector drops. This lowers the top plate of the capacitor and since the capacitor is slightly charged, the bottom plate drops to a voltage less than rail voltage. This action turns ON the first transistor to start the next cycle.
This circuit provides **REGENERATIVE ACTION** via the capacitor, to turn ON the first transistor HARDER and HARDER and this turns on the driver transistor to FULL SATURATION. In other words, one transistor DRIVES the other transistor into full saturation, and this feature is not provided in the poor design above.

HUMIDITY SENSOR

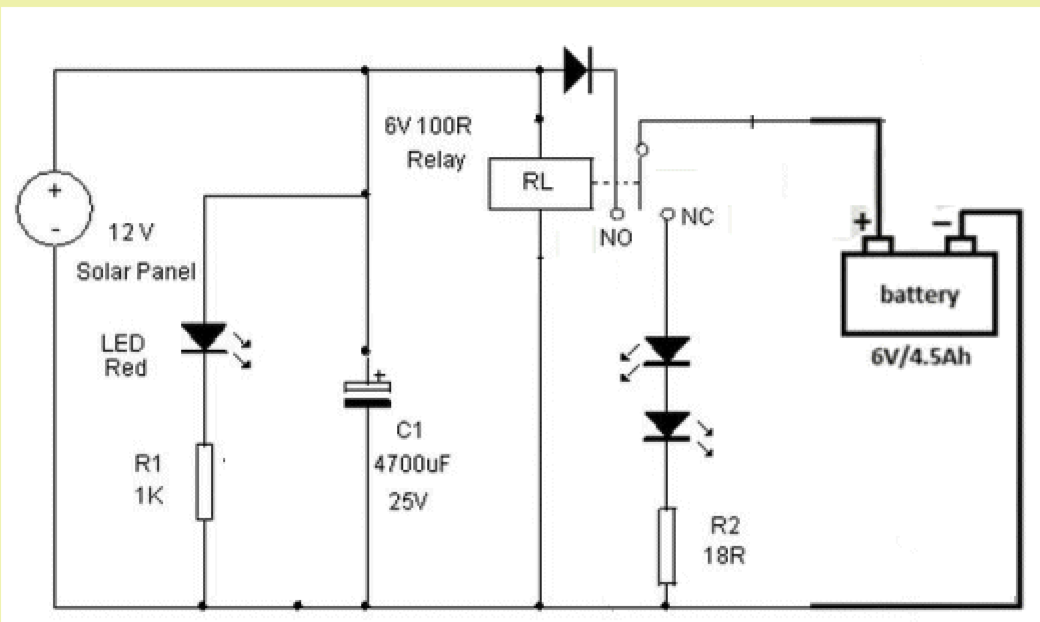


This circuit has a number of mistakes.
Apart from being overly-complex, the operation of the circuit needs explanation.
The first two transistors form a Schmitt Trigger.
Diode D1 serves NO PURPOSE and can be removed.
The designer of the circuit states that as the resistance between the two sensors decreases the circuit will latch the relay. This is NOT TRUE.
Let's look at it:
The first transistor is NOT TURNED ON. (It is the same as being removed from the circuit).
The second transistor is TURNED ON. The voltage on the collector is LOW and the 100p is charged.
If the sensors are connected together, the two transistors will change state and the collector of the second transistor will go HIGH but this will not change the state of the latch.
The sensor has to go from a low-resistance state to a high-resistance state for the circuit to change states.
When the sensor is low-resistance, the maximum collector current is flowing through the 2k7 and a small voltage is developed across the 56R.
As the sensor-resistance increases, the voltage on the base decreases slightly and T1 turns OFF a small amount. This turns ON T2 and the current through the 39k adds to the current in the 56R to produce a slightly higher voltage across this resistor. This reduces the base-emitter voltage for T1 and has the effect of turning of T1 slightly without and change in the sensor resistance.
In other words the circuit suddenly changes state without any change in the input conditions.
This pulls the left lead of the 100p down and triggers the latch to changes states.

Here's another one of Professor D.Mohankumar's circuits:



A 12v solar panel will produce 15v - 16v and this is too high for a 6v battery. A 6v solar panel should be used.
The relay is 6v and a 6v panel should be used. The two diodes are not needed.
The NC and NO connections on the relay are around the wrong way.
The diode across the relay is not needed as the voltage rises and falls very slowly.
The 1 watt High-power LEDs drop 3.6v each and will not illuminate on a 6v battery.
Just another untried, untested circuit to mess up the electronics experimenter.
The circuit is such a mess that I could not work out the fault.
Here is the corrected circuit:



When you draw the circuit correctly, you can see the original design needs a diode as shown because the relay would not drop out when the solar panel receives no illumination. Obviously the circuit has never been tested.

An Appeal

It is found that many Circuits from this blog are appearing in some websites without permission. This is a violation of copyright. Unnecessary comments are also added along with such posts without testing the circuit and only by mere assumption. So please remove such comments from those web-pages in order to avoid confusion in

electronics beginners. All the circuits in this blog are tested OK through bread board assembly .

http://dmohankumar.wordpress.com/top-circuits/

"All the circuits in this blog are tested OK through bread-board assembly."

What RUBBISH !!!

Nearly ALL his circuits DON'T work and after telling him of the faults with more than 20 of his designs, none have been corrected.
This is the danger of allowing inexperienced "Professors" to publish their rubbish on the internet and fail to redress the situation by correcting their mistakes. They cannot believe they are making such a fool of themselves.
There are many sites where "eminent" teachers and experienced technical personnel are stating things that are totally inaccurate, out-of date (using PNP transistors), or designing circuits that simply DO NOT WORK.
I have contacted many of these owners and failed to receive a reply.
This is very frustrating as receiving incorrect information is very damaging and it's obvious these web owners should not be in the disseminating field.

The emergence of the internet has improved the scope for learning for millions of people.
Not one those living in third-world countries, but those in outlying areas as well a city-dwellers now have the opportunity to read and view videos of the latest news in every aspect to world affairs.
Every film, newspaper, video and and article ever-written can be looked up and studied.
It does not matter what your interest, it can be obtained FREE on the internet.
In the next 10 years, 1 billion extra readers will have access to the web and this will put added burden on the infrastructure but it will allow an enormous increase in material to be added.
Here is an email from a reader in India, with his account of his access to the internet:

I read **Electronics For You** from the age of 14yrs, I got so confused reading these circuit ideas that I used to ponder how electronics worked. After 2-3 yrs (1990) of wandering I found a magazine called **elektor electronics** in a local library, I had to admit that this magazine taught me what electronics is really all about. I never subscribed to ‘EFY’ because it is a show-off magazine; that’s all.

Almost each and every issue was full of either faulty circuits or incompletely described projects and missing part numbers (like IC1, U2 !). Some projects were published in multiple parts and then abruptly discontinued! – they never published the remaining parts. A few of them were mere mock-ups from other resources. The internet was not very accessible in my town, a few cafes in remote places were very costly (2-3dollars/hour @ 1-10kbps!). I was earning $1.00 per hour. But only after the real introduction of the internet I came across a plethora of knowledge (maybe it was 2000-2001) and found the resources they were copying from.

The magazine used to publish some impractical designs. For example “Fuzzy control” was a new technology then within 5-6 months they published a hazy, badly-reproduced (hand drawn figures that were not explained and were not discussed at all) article that showed how modern the magazine is, but the way they put the idea of “Fuzzy control” it looked nonsensical and showed the author didn't have a grasp of the technology. Later I found a better explanation on the internet and other magazines.

I have attempted a few of the projects in EFY and ended in confusion many times. Even a ‘walkie talkie’ project failed! Compared to ‘talking electronics,’ you so neatly explained the radio transmitters that instantly reveled why my projects almost always failed.

My point is this. The magazine never explained anything correctly. It opted for “go seek elsewhere” instead.

I subscribed to ‘elektor electronics’ for 10yrs. It was out of circulation in India for some time and become irregular so I had to discontinue. Here in India ‘electronics’ is considered more like voodoo. Learning here is more like; what a tape-recorder does, listening then reproduce the same, no need to understand the subject.

I came across your site very recently, I really regret not finding it sooner. The site told me to ‘look no further’.

Thanks for providing the knowledge and great guidance.

Rahul

Here's another one of Professor D.Mohankumar's circuits:

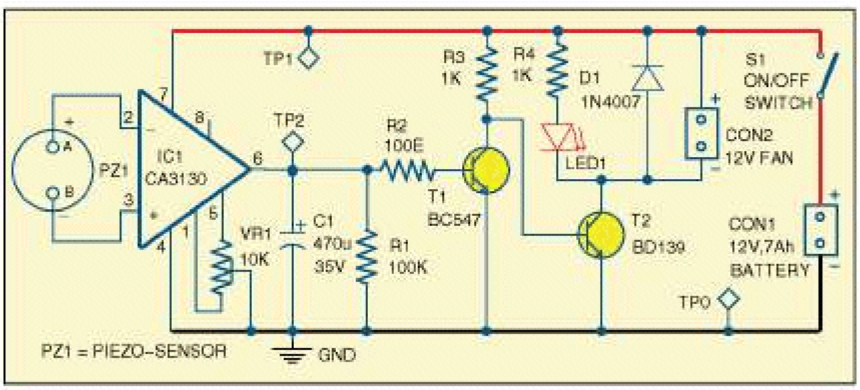
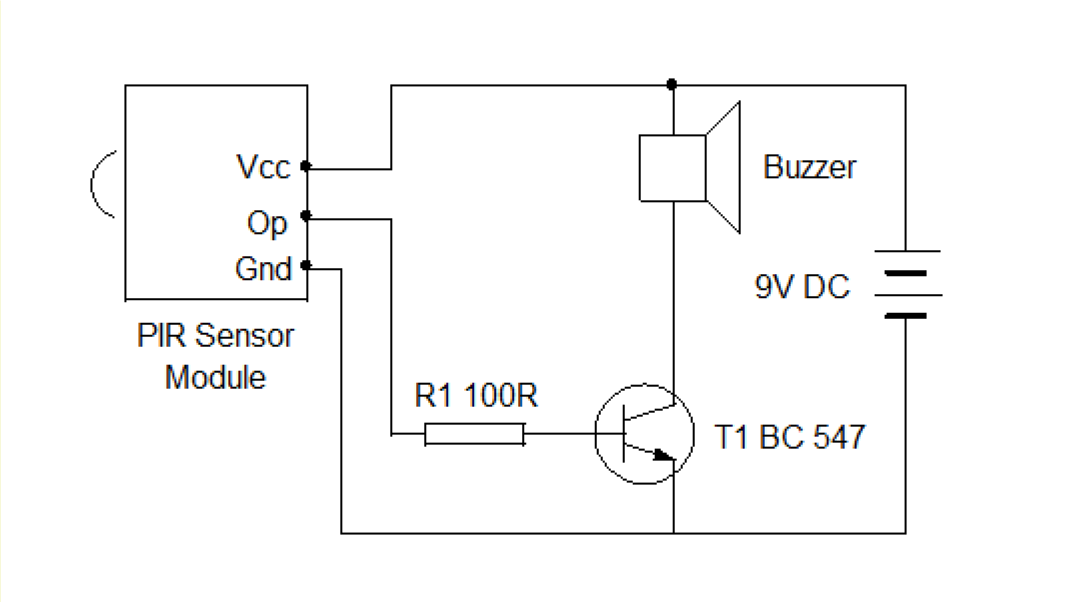


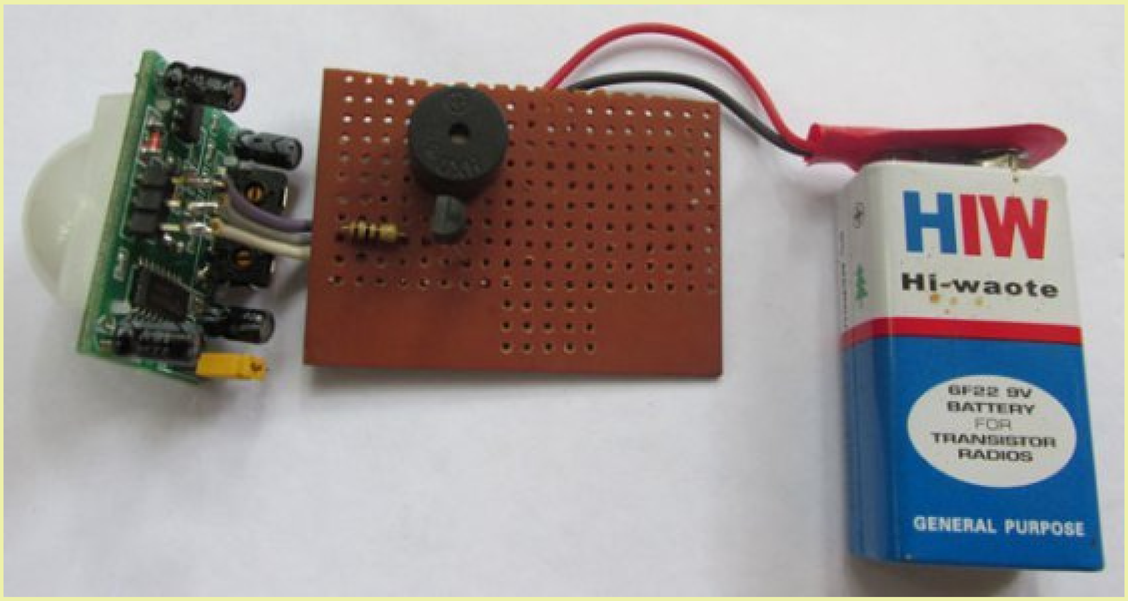
Fig. 2: Circuit diagram of solder fumes remover

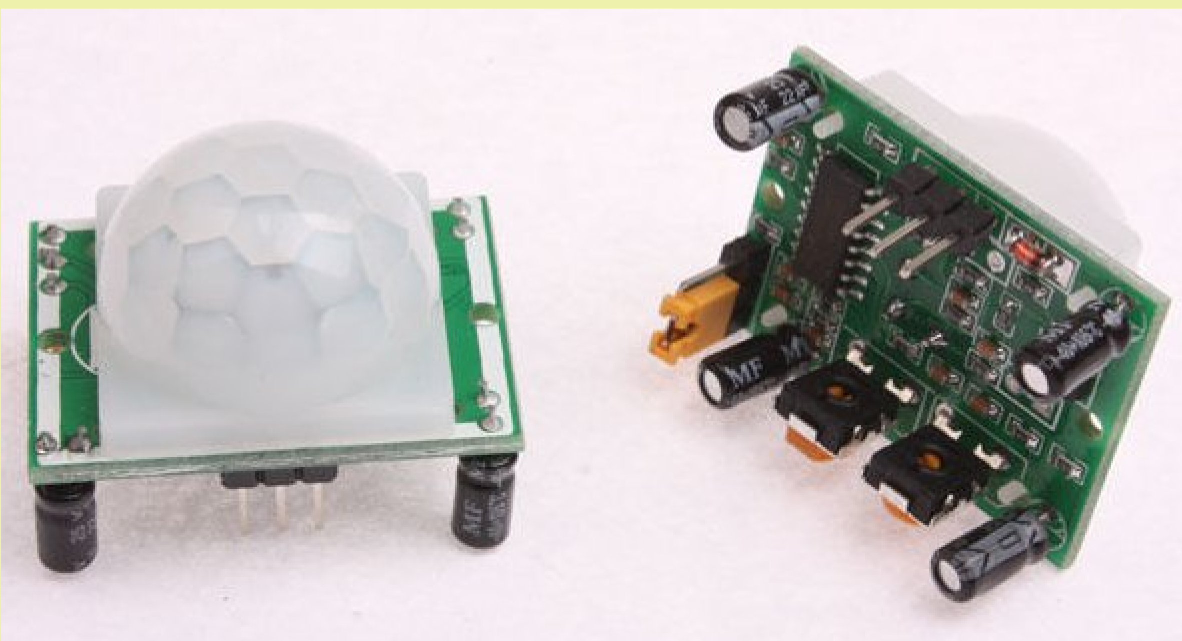
It turns on a fan when your soldering iron is back in the stand.
Why bother to turn the fan on-and-off????
If you want to turn it on and off, just put a micro-switch under the stand and when the iron is replaced, the switch will turn on. It doesn't need a Professor to think of a solution.

The output of the CA3130 has sufficient drive-current to drive the BD139 directly.
The 100R on the base of the BC547 is far too low.
R1 is not needed.
The 1N4007 is not needed.
I tried a piezo diaphragm near a soldering iron and it did not register 1v output, as stated by the Professor. It just got hot.
This is a silly circuit for a problem that does not exist.

Here's another of Professor D.Mohankumar's circuits. He has absolutely NO IDEA how to design a circuit, and even though the circuit has just 3 components, it is a TERRIBLE design.
The base resistor for a BC547 should never be as low as 100R. A BC547 has 100mA as the maximum allowable collector current and the base current should be a maximum of 5mA. A higher base current is not needed and shows the designer does not know what he is doing.
The transistor in this circuit takes about 80mA base current. This is a complete waste of 75mA.
The base resistor should be about 1k5.



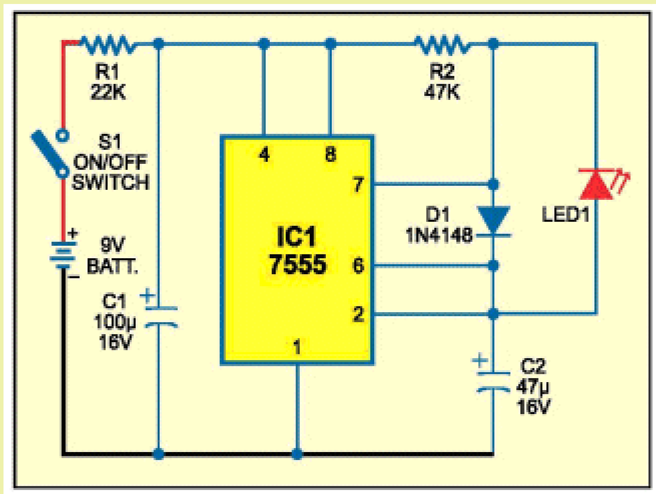




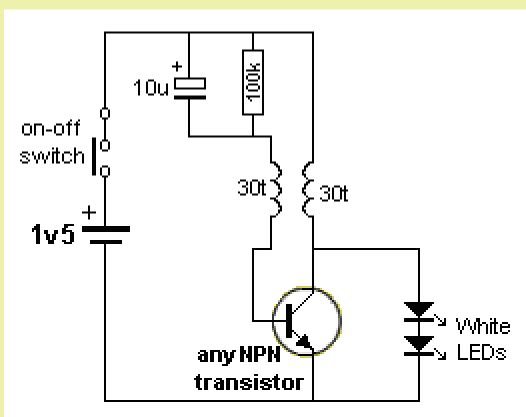
These modules are available on eBay for $2.00 (post free !!!!!!)

Bike Flasher

Here is an example of an over-designed circuit. Not only does the circuit use too many components, but the cost is high and the 9v battery is expensive.
A 9v battery has the same energy as an AA cell.
You may think the LED is up-side-down but the pin 7 turns on and illuminates the LED but there is no limiting resistor.
Capacitor C2 charges through resistor R2 and diode D1. When the voltage across C2 reaches two-third of the supply voltage, threshold pin 7 of IC1 switches on as a current sink. The capacitor discharges through LED1 into pin 7 rapidly. Diode 1N4148 (D1) provides the one-way charging path for capacitor C2 via resistor R2. LED1 illuminates briefly for a while with the accumulated charges in C2. Again, the charging cycle repeats. This way, LED continues flashing. A 9V PP3 battery can be used.



Here is a simpler, cheaper circuit. It uses a single AA or AAA cell:



Before you put a circuit into a magazine, you need to check all the available circuits and see what has been done.

Here's a badly designed circuit from electronicsproject.org:

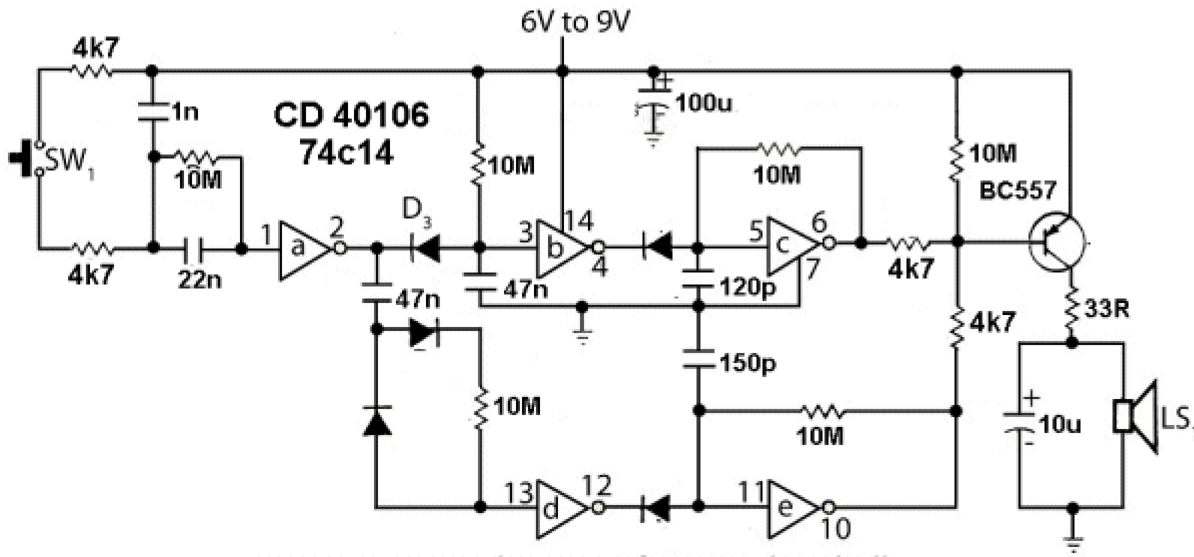
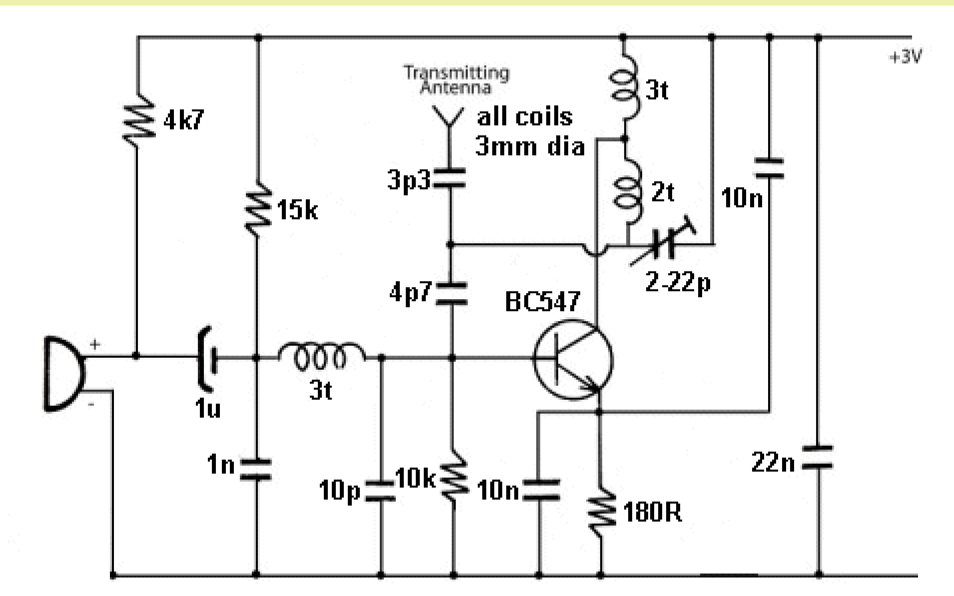


Figure 1: Circuit diagram of 2-tone door bell

Pin 1 of the IC is floating. The output could be HIGH or LOW and the circuit will false-trigger.
Pin 13 is floating.
It is a very bad arrangement to use 10M resistors as any moisture on the PC board will change the resistance of the circuit.
The 10u across the speaker will reduce the output.
There is no way to determine if the circuit will work until these two faults are corrected.
A badly designed circuit by someone who knows nothing about electronics.

Here's a circuit from electronicsproject.org:

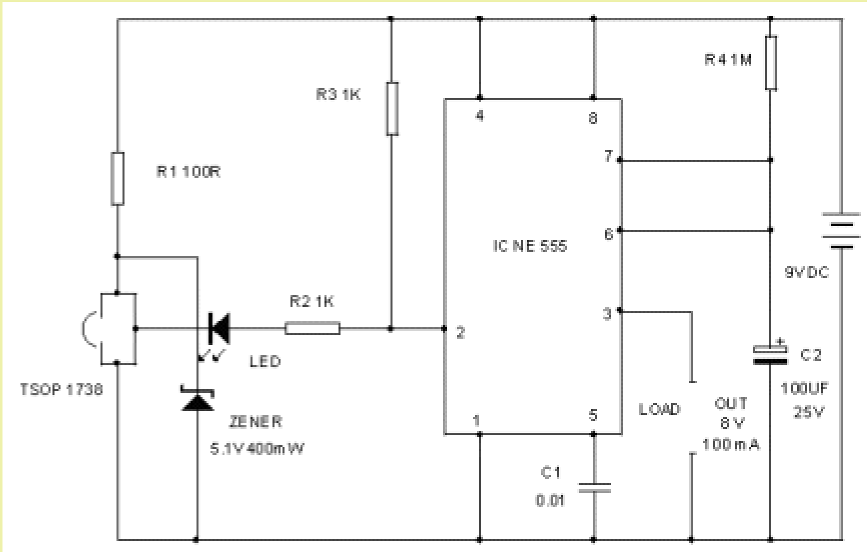


FM Transmitting Circuit

The circuit is completely different to all the FM transmitter we have presented on our website.
The circuit above is a common-emitter stage and does not have the good performance of a common-base circuit as descried in our designs.
However it would be a good idea to build the circuit and see how it performs.
The top 10n is not needed as the emitter is held rigid by the lower 10n.
10p on the base does nothing.
Use one of our Field Strength Meters to determine the output power.

D. Mohan Kumar M.Sc., M.Phil, is an Associate Professor from Trivandrum, Kerala, India. He has been producing faulty electronic circuits ever since he started putting his rubbish on the web.

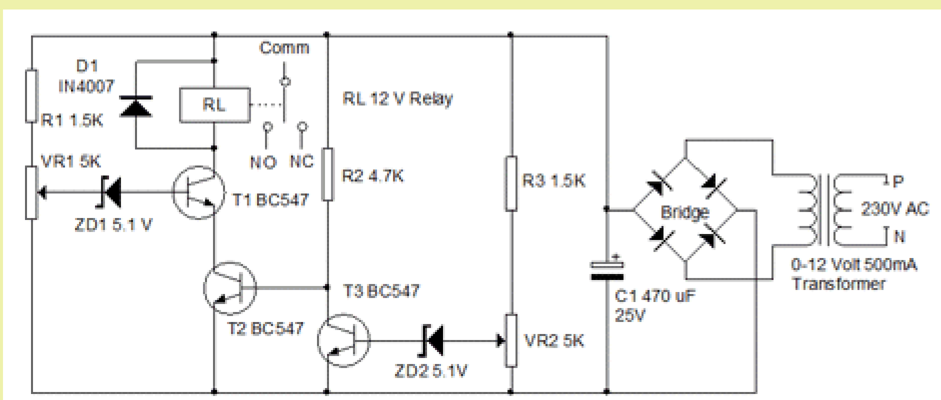
He has been told for the past two years about his junk circuits but he keeps displaying his total lack of electronics knowledge and messing up all those who visit his site. It is no wonder Indian hobbyists are incapable of designing anything electronic. They have total idiots teaching in the Universities.



IR RECEIVER

This circuit will never work. Pin 2 will never go LOW. The two 1k resistors will keep pin 2 above 50% and it has to reach 35% to trigger the 555.
Another untried and untested circuit from Professor Mohan Kumar.

Another circuit from Professor Mohan Kumar:



The bridge has the positive going to the 0v rail.
There is no need for the 5v1 zener diodes.
They can be removed and the pots re-adjusted to produce the same effect.
The protection diode is not needed because the relay is being turned off very slowly.
See our simpler circuit in 200 Transistor Circuits.

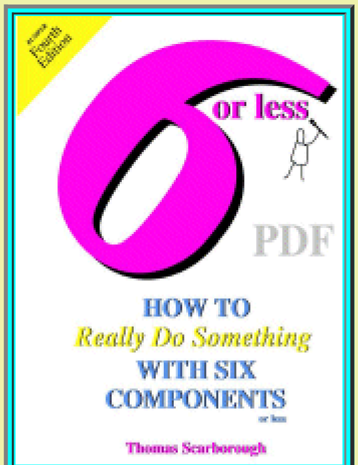
Here's technical mistake from one of the electronics forums from **Eliminator**.
He says:
"actually any ordinary transformer having current rating 1/10th of battery AH and voltage a little higher than the battery specs will work perfectly for charging all lead acid batteries…..that's as simple as it can be."

He is saying an ordinary transformer can be connected directly to a battery without any current-limiting resistor.
Firstly, where can you get "an ordinary transformer" with an output voltage suitable for a 12v battery charger ???
Why do you think battery-charger transformers are accurate to half-a-turn?

Charging a battery is very similar to delivering a voltage to zener diode. If the voltage is higher than the zener voltage, theoretically an infinite current will flow.
If the voltage from the transformer (after the rectifier) is higher than the battery voltage, a very high charge-

current will flow. This can be higher than the rating of the transformer (such as 1 amp) and can be as high as 2 - 4 amps. This will "burn-out" the transformer.
That's why you have to be careful.

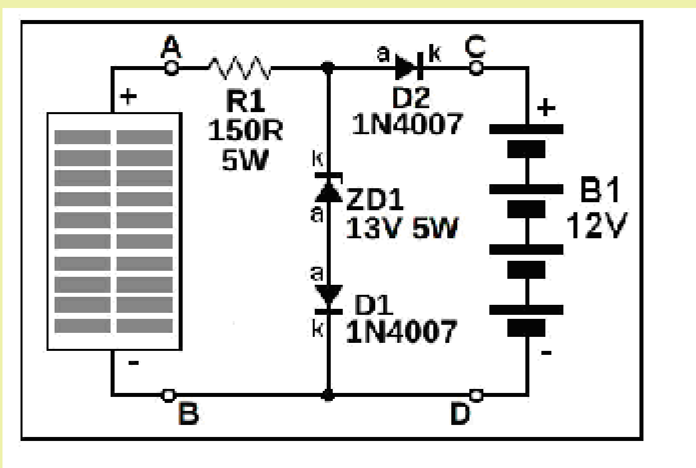
A new eBook on the market contains a lot of mistakes.



This is the eBook, with the enormous number of mistakes.

Click HERE to see some of the pages of the book on the web.
Click HERE to see some more of the pages of the book on the web.
Click HERE to see the remaining pages of the book

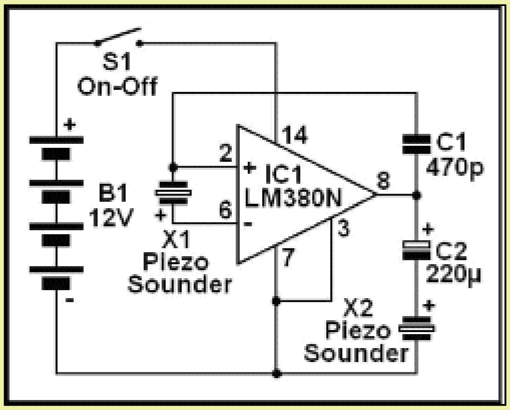
The most glaring mistake is the solar charger circuit:



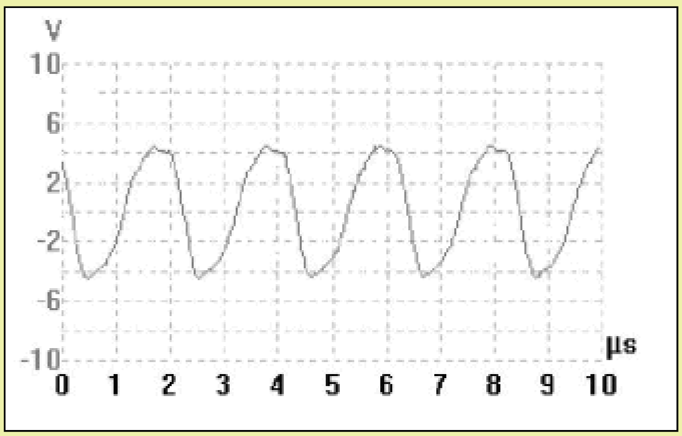
The book states the solar panel is 12v @ 5 watt. This means the panel will deliver about 400mA.
The text says the circuit limits the current to 100mA. Why waste 75% of the generated power ????
The first mistake made by the author is the addition of the 13v zener and diode D1. This will only allow 13.6v minus 0.7v from diode D2 to enter the battery. This is 12.9v and the battery will never charge.
The next mistake is the 150R resistor.
A good quality 12v panel will have sufficient solar cells @ 0.56v to produce about 18v on a sunny day.
Suppose we take away the zener diode and D1.
This means the battery will charge and generate a "floating charge" of about 15v.
If the panel generates 18v and the battery voltage is 15v plus 0.7v from diode D2, the voltage across the 150R resistor will be 2.3v
The current through the resistor will be 15mA.
Thomas Scarborough disputes these figures. He failed to supply his own figures and says the question is baffling.
How can a technical writer say the problem is BAFFLING ??????
He also says the book has been proof-read by qualified electronics writers and the circuit works.
It's no wonder people are buying fewer and fewer books.

So many are filled with mistakes and when the writers are approached with a list of corrections, NOTHING GETS DONE.

Here's the next fault:

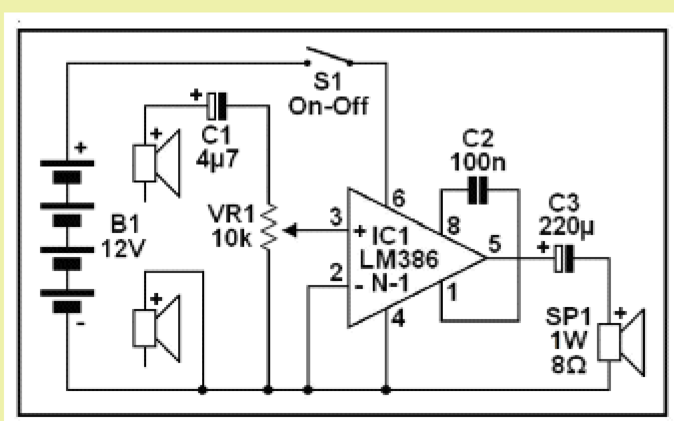


The text states the 220u is needed to prevent the IC overheating. The capacitance of a Piezo Sounder is about 22n. Adding a 220u will make no difference to the output impedance. The 220u is not needed.
See our simpler circuit SONIC DETECTOR using two transistors in eBook: 200 Transistor Circuits



The graph represents a signal of about 500kHz, way beyond the capability of the chip and the transducers.

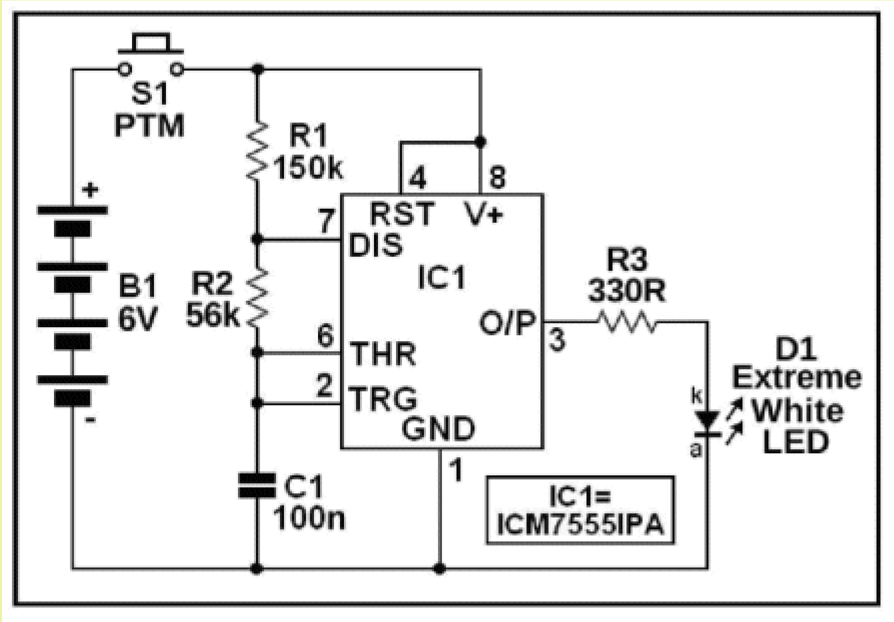
Next mistake:



AMPLIFIER

The writer claims the LM386N-1 outputs 1 watt. The data sheet states 325mW !!!!

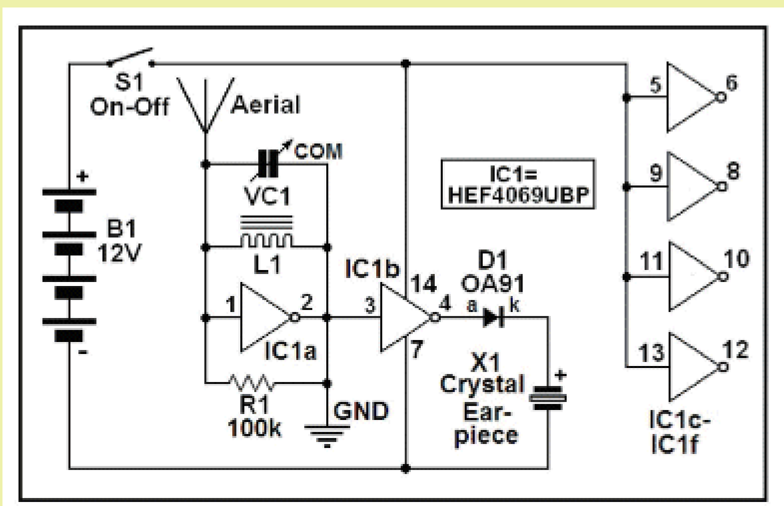
Next fault:



LED TORCH

This is a totally unnecessary circuit. The supply voltage is sufficient to drive the LED via a resistor. The circuit is simply pulsing the LED to produce a lower output than if the LED were connected to the battery via a resistor.

Next:



CRYSTAL RADIO

What is the purpose of the 100k ???? It is not needed.
The output of the first gate is connected to ground!!!!! How do you expect the signal from the first gate to get to the second gate !!!!
The writer claims the diode must be a germanium type due to the fact that it only drops abut 0.3v whereas a silicon diode drops abut 0.7v.
This may be true for a normal crystal set where the voltage developed are very small as no battery is used. But when the supply is 12v as shown in the circuit above, ANY DIODE can be used. The text also says: **Most if not all germanium diodes should work in this circuit.** All diodes WILL WORK.
The crystal earpiece needs a resistor across it to discharge the earpiece.

This circuit shows a complete lack of understanding of electronics. Where are the proof-readers ???

Here is another terrible mistake:

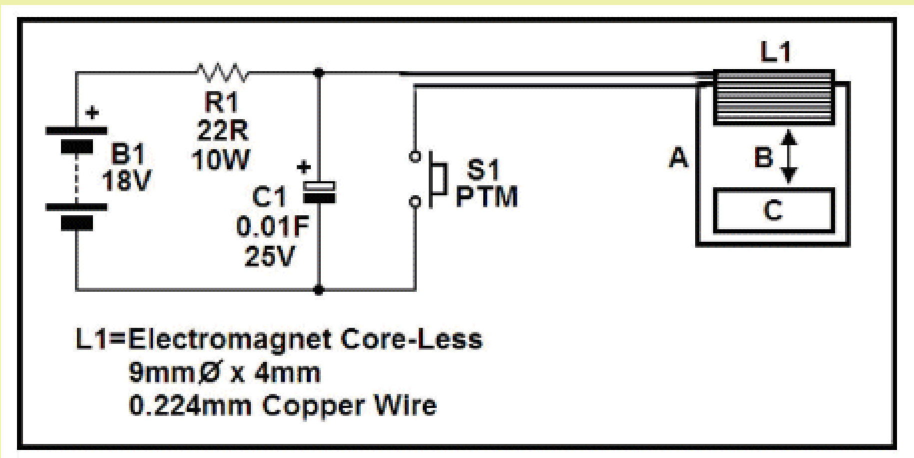
The text says: the circuit uses 6v, which is 2.4v above the typical forward voltage of a white LED. But such LEDs will happily endure a higher forward voltage, on condition that they are pulsed. In fact in experiments white LEDs endured sustained testing at 10v.

This shows complete lack of understanding of LEDs.
The forward voltage for a white LED is about 3.2v to 3.6v. The actual voltage depends on the manufacturer and the LED. If the characteristic voltage is 3.2v, you MUST NOT supply it with a voltage above this value because the current will increase considerably and damage the LED.
To deliver 10v to a LED is absolute madness and giving the wrong information to beginners.
All LEDs need to have a current-limiting resistor in series. This will allow the LED to generate its own, individual, characteristic voltage and if the resistor is the correct value, the current will be limited to between 1mA and 17mA for normal operation or up to 40mA for pulsed operation.

The author suggests a 10-turn 20k pot for some of the circuits.
Apart from being hard to get, this type of pot is the worst suggestion for an experiment. It is impossible to know where the wiper is positioned and you don't know which way the wiper is moving when you turn the screw.
And you don't need the accuracy. Just a terrible suggestion. I avoid them like poison.

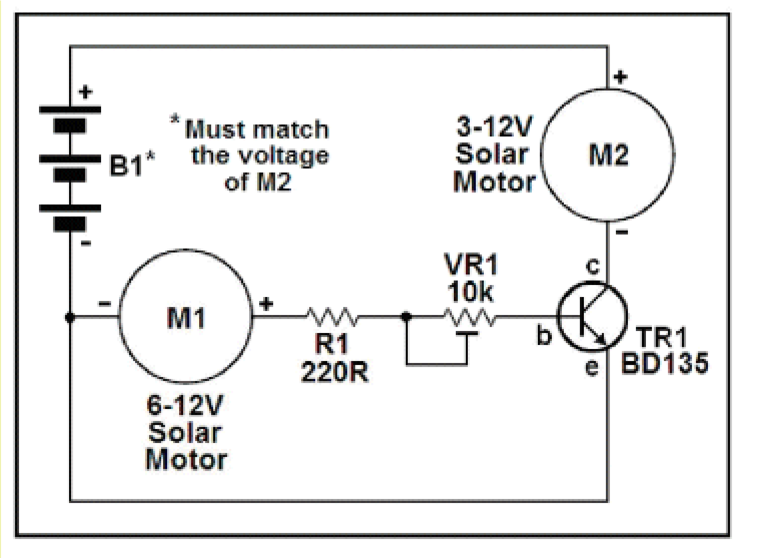
The writer has used a BAT85 diode in many of the circuits. It is a very bad policy to use a special component when a general-purpose device will work. You are giving the impression that the component has some special characteristic. In the cases of the circuits in this eBook, a 1N4148 signal diode can be used.

Another technical mistake:



JUMP COIL

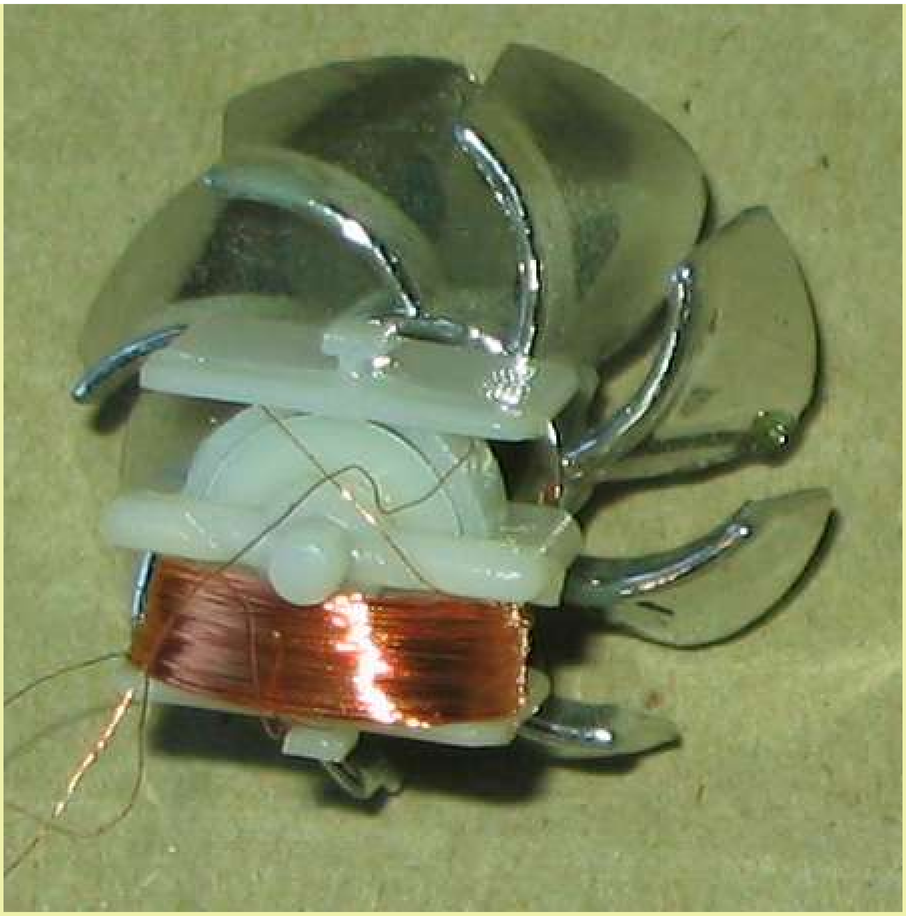
L1 is a coil and the supercap 10,000u is charged via a 22R resistor. When the switch is pressed, the energy from the supercap goes to the coil to make a metal disc jump.
The 18v is made from two 9v batteries. The 22R resistor is too low. It should be 220R so the switch can be pressed briefly and the battery will not have to supply a very heavy current.



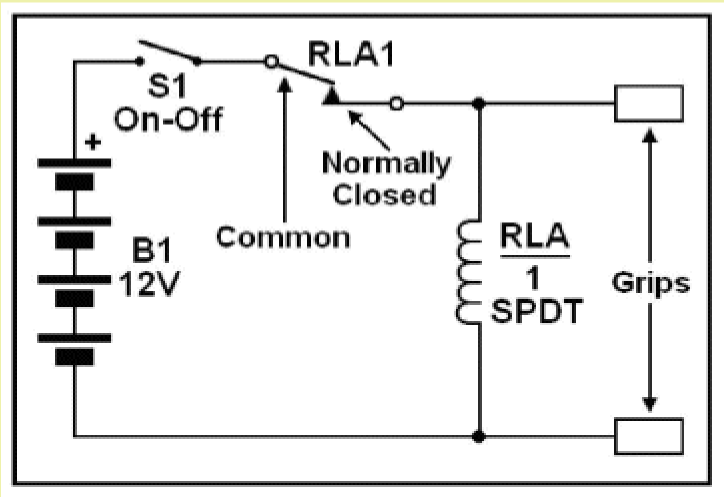
ANEMOMETER

What is a SOLAR MOTOR ??

No mention is made of the design of the solar motor, however it is basically an AC GENERATOR.
It is also commonly called a DYNAMO and consists of a magnet rotating inside a coil of wire. There are no brushes and as the magnet rotates, it produces a sinewave. There is no brush-friction with this type of generator and it will revolve with the slightest amount of wind. There is no metal core for the coil as this would create resistance as the magnet rotates. It is actually a very special type of generator that has no resistance to the turning of the shaft.
The following photo is a wind generator with blades. You can see the coil of wire and the circular magnet within the housing. It would be nice to have this explained in the eBook. (Bought at a $2.00 junk shop for $2.00)
You have to go to all different types of shops to pick up different electronic devices. You never know where you will find something interesting. This wind generator sticks to the outlet of your car air conditioner and spins to illuminate a number of different-colour LEDs. Toy shops are also a source of amazing gadgets.

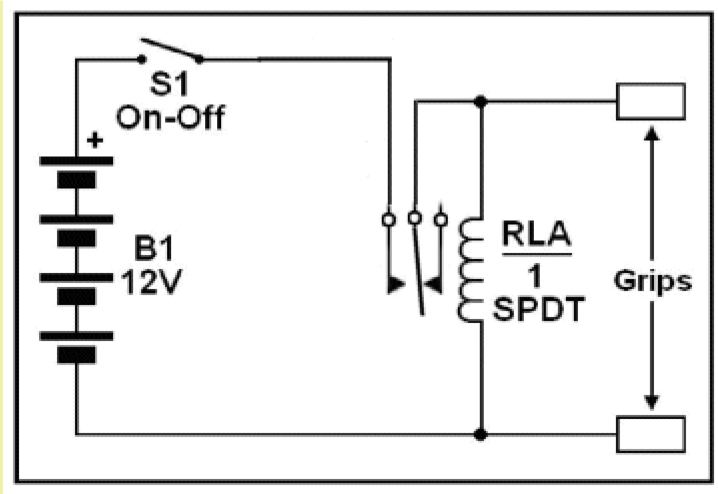


AC GENERATOR - called a DYNAMO



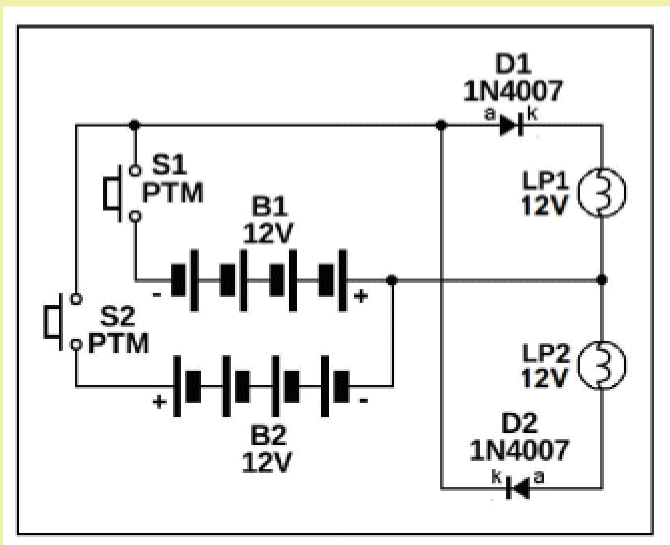
RELAY VIBRATOR

If the circuit is drawn clearly, you can see how the contacts work:



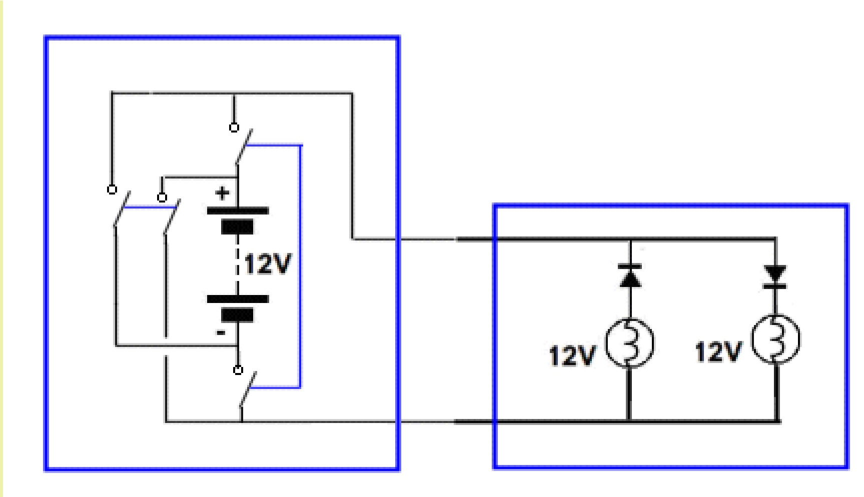
RELAY VIBRATOR

2-LAMP TRICK



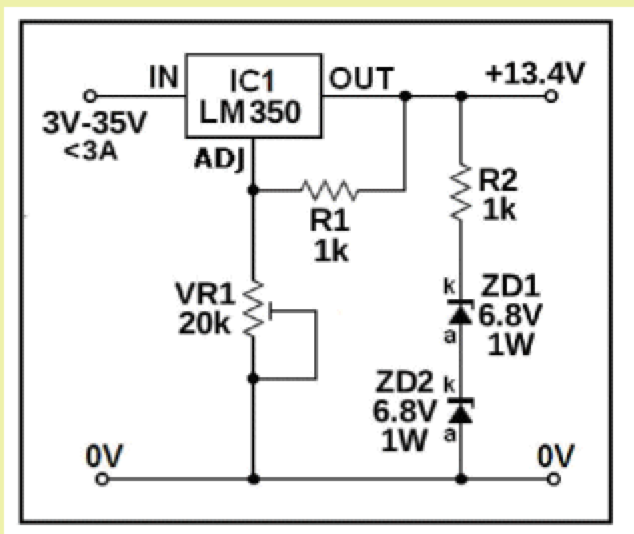
2-LAMP TRICK

When one switch is pressed the top lamp illuminates. When the other switch is pressed, the lower lamp illuminates.
If you press BOTH switches the two batteries will be in a SHORT-CIRCUIT state.
The circuit is badly drawn. You cannot see how the components are arranged.
The following diagram makes this clear and only uses a single 12v battery:



2 LAMP TRICK

SOLAR BATTERY CHARGER



The solar battery charger circuits presented in the eBook are over-designed. If the battery is used each night, it will take all day to charge and providing the current is 100mA for each A-Hr of the battery, you will not need any regulation circuitry.
A battery will not charge when the output of the charger is 13.4v.
A battery develops a voltage across its terminals of about 14.5v to 15.5v due to the activity within the cells and the charging voltage needs to be higher than this to allow a current to enter the battery.
All these points are totally missed in the eBook and the writer says he has installed systems in Africa.
He does not have a website so he doesn't know if the systems are working correctly as he cannot get any feedback.
He says all these theoretical calculations of mine, don't apply. Who says they are theoretical !!!!!!
This is the sort of comment I get from all the writers who have presented dodgy circuits and if you go to the electronics forums you will find requests from readers who have built these types of circuits and failed to get them working.
How do you think all the simulation software works???
It works on theoretical values. The gain of a certain transistor when 100mA is flowing, cannot be worked out. It comes from known parameters that are not linear values.
To say the charging current cannot be determined is just rubbish.
To have a writer like this in charge of a publication for beginners just shows how little he knows about electronics. Even the first hour of glancing though the eBook, highlighted the fact that the writer had very little knowledge on many aspects of electronics. The fact that he has produced lots of simple circuits is just a product of continual experimentation. But when it comes to describing how the circuit works, the descriptions are bemusing. How can you get a "slow oscillator" with a Schmitt trigger gate? I think he means a low-frequency oscillator because the

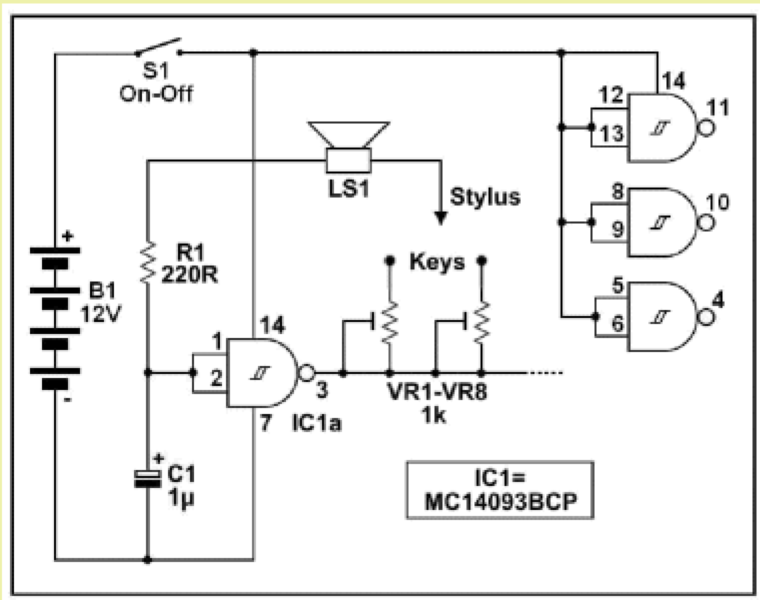
output changes state very quickly. It does not matter what is happening inside the circuit-block as the capacitor is always charging and discharging slowly. It is the output that is described as high-frequency or low-frequency.

STYLOPHONE

Oscillator IC1a may be likened to a conventional RC (resistor-capacitor) oscillator, except that R is largely replaced with L (inductor LSI, the loudspeaker). An inductor works by opposing electrical pulses (called reactance), in this case impeding the charge and discharge of C1.

TWO TECHNICAL FAULTS.

1. The resistance (and or impedance) of the speaker is so small that it has almost no effect on adding to the resistance of the trim-pot and has almost no effect on changing the timing circuit. The effect of the speaker is NOT a major part of the timing circuit.
2. The timing circuit is NOT designed to impede the charging or discharging of the capacitor by an inductor or inductance. It is purely an RC timing circuit.



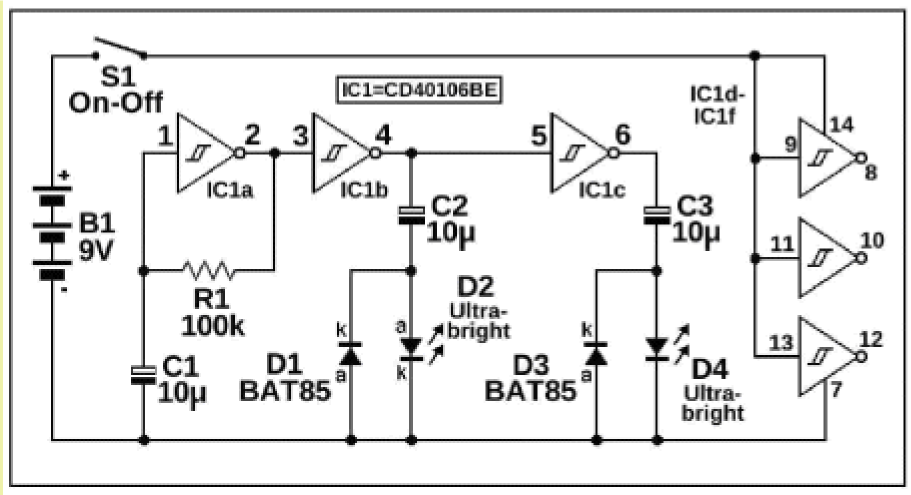
STYLOPHONE CIRCUIT

ALTERNATE FLASHER

The text in the eBook is **COMPLETELY WRONG**:
When IC1b output pin 4 goes "low", so C2 draws a pulse through LED D2. When IC1b output pin 4 goes "high", so C2 recharges through D1.

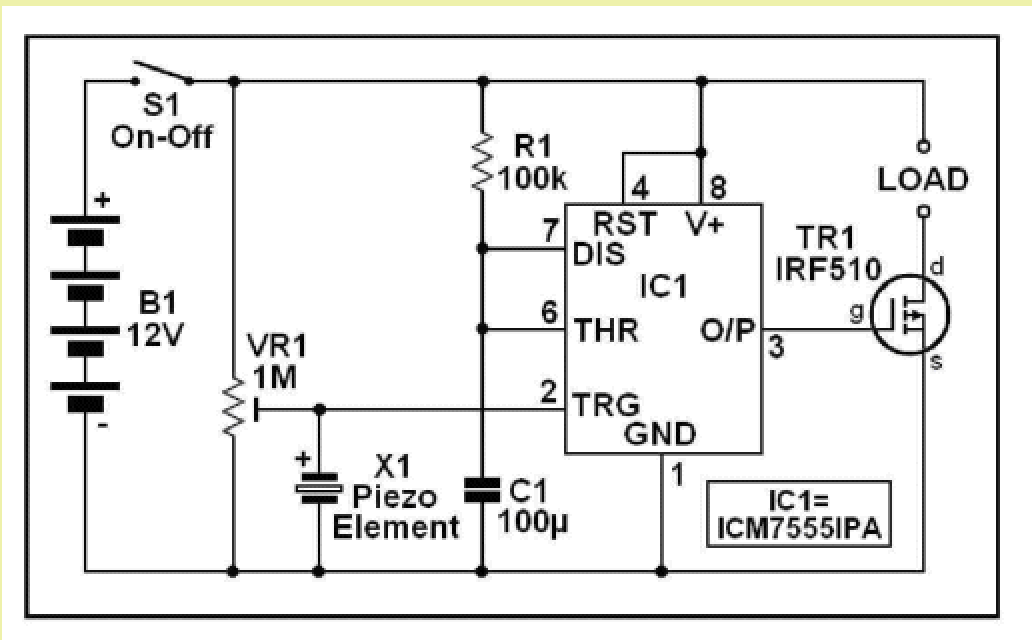
The correct explanation is as follows:
When IC1b output pin 4 goes HIGH capacitor C2 is not charged and it acts like a very small value resistor. This allows current to flow through the Ultra Bright LED D2. The 10u charges very quickly and the LED flashes for a very short period of time.
Capacitor C2 is now fully charged and when output pin 4 goes LOW, it pushes the negative lead of the 10u BELOW the 0v rail. This allows D1 to conduct and discharge the 10u. It is not ready to flash the LED again when the output goes HIGH.

Thomas Scarborough knows NOTHING about the operation of this simple circuit and should not be producing a book for beginners and delivering FALSE INFORMATION.



ALTERNATE FLASHER CIRCUIT

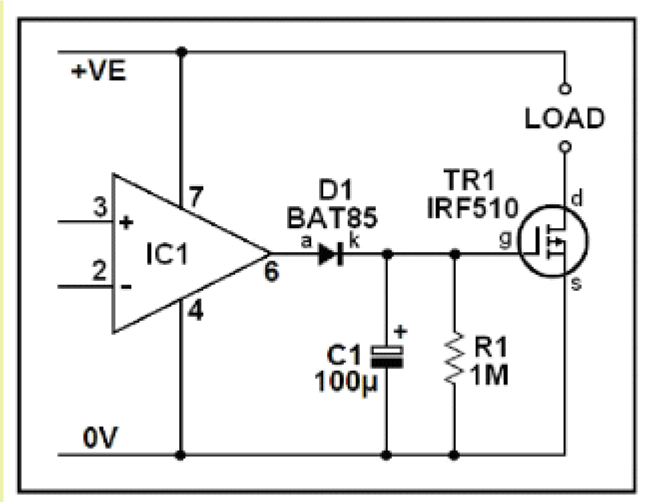
VIBRATION DETECTOR



VIBRATION DETECTOR

The text says:
IC$_1$ is wired as a standard monostable timer. It is based on the well known 555 timer IC—however, note that this is a more sensitive 7555 *CMOS version* of the IC.
Why specify a CMOS version of the chip? What does the text mean by: more sensitive? and why is it important when you have lowered the input impedance of pin 2 to less than 500k. You can use an ordinary 555. If the text means "low current" and you need to use a battery, a 7555 will consume about 1-2mA compared with 10mA for a 555. This circuit is not a good design as pin 2 does not detect small changes in voltage. The 555 is not designed for this purpose.

DELAY CIRCUIT



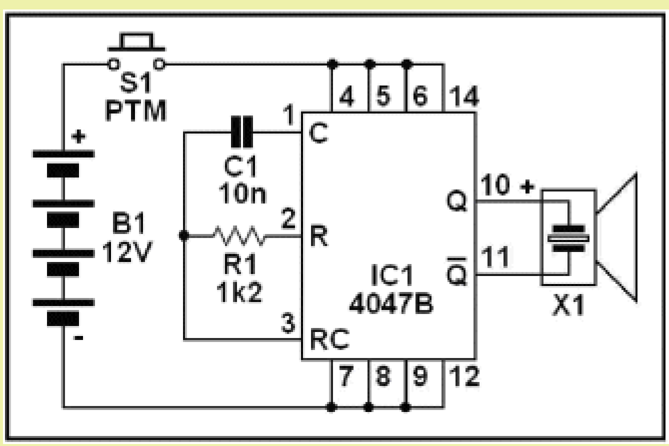
DELAY CIRCUIT

This circuit will only work with a MOSFET or FET for TR1— or with a CMOS gate in the same position—since this is essentially a static-controlled device. This circuit will not work with a common bipolar (npn or pnp) transistor in the position of TR1, since charge, in that case, would leak away very fast.

Some improvements need to be included to make the text in the book clear:
The voltage on the 100u will not rise above 0.7v if an ordinary transistor is included because the base-emitter voltage never rises above 0.7v.

DOG BARK STOPPER

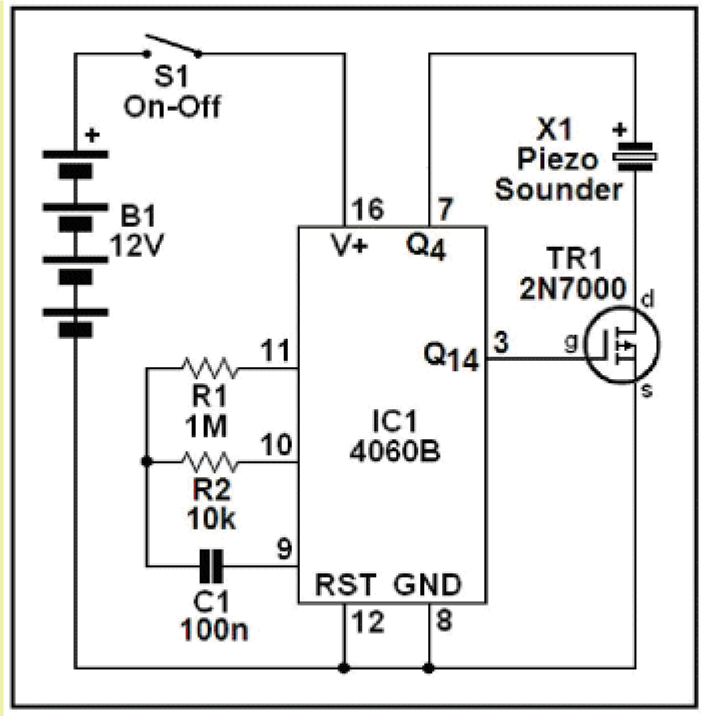
The drive-current for each output of a 4047 IC is about 10mA. The output volume of this circuit will be very low and not effective. All our Dog Bark Stopper projects use buffer transistors to get the maximum output. It needs nearly 1amp drive-capability of the circuit to get a load output from a high-frequency piezo tweeter. See Dog Bark Stopper Project.



DOG BARK STOPPER CIRCUIT

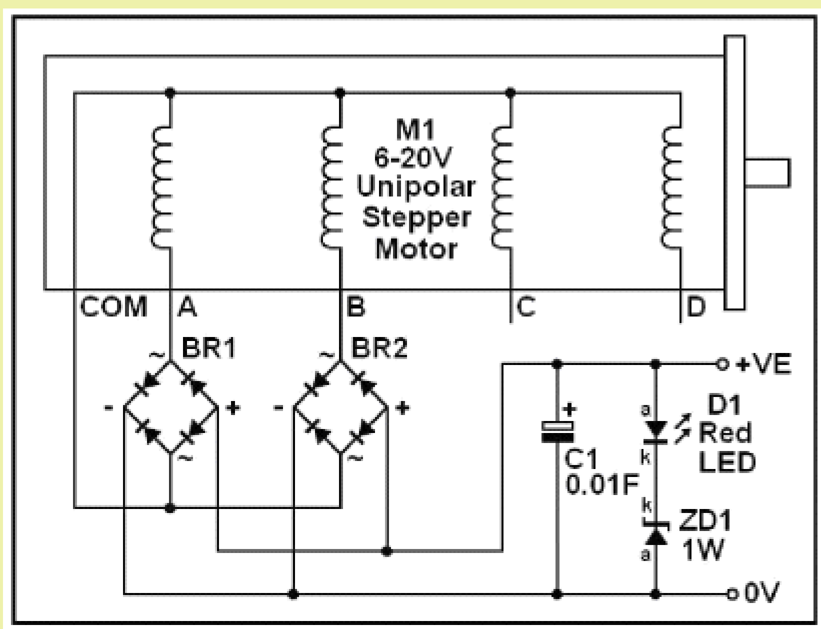
BIRD SCARER

Why use a MOSFET transistor when the piezo transducer could be connected directly to pins 3 and 7. The output volume will be the same - very low.
Q4 is divide by 16 and Q14 is divide by 16,000. This means you are going to get a beep (tone) followed by the same length of time as silence.



BIRD SCARER CIRCUIT

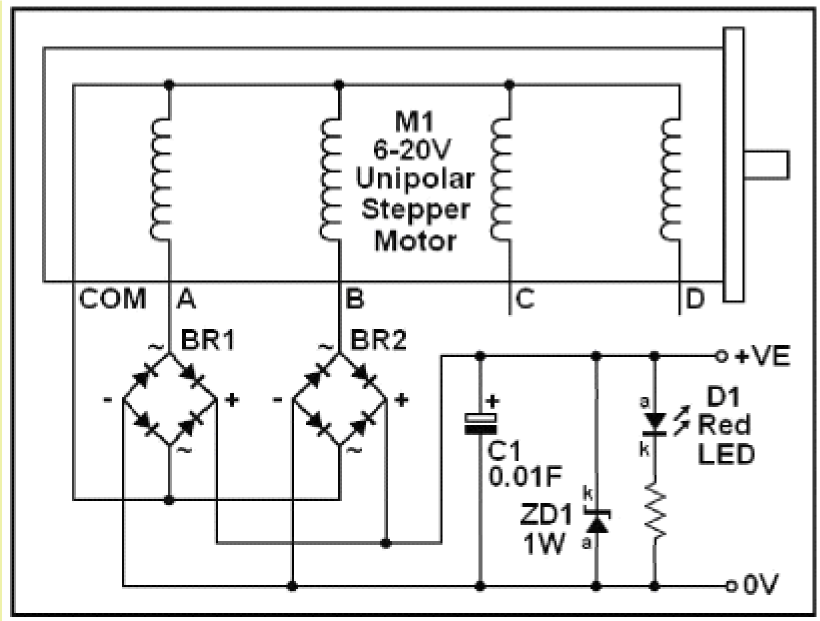
STEPPER MOTOR



STEPPER MOTOR CIRCUIT

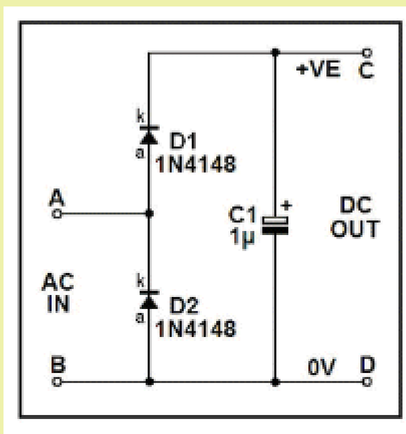
The two bridges are identified incorrectly. The zener diode is not protecting the red LED from high current generated by the stepper motor. It is merely changing the voltage at which the high-current will start to pass through the LED and damage it. For instance, if the zener is 5v6 and the red LED has a characteristic voltage of 1.7v, as soon as the voltage across the 0.01F supercap reaches 5.6 + 1.7 = 7.3v the LED will be damaged.

The correct circuit is as follows:



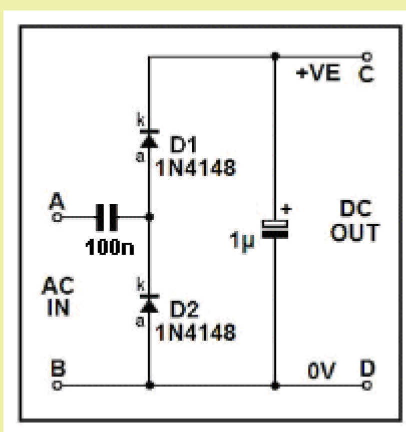
STEPPER MOTOR CIRCUIT-2

DIODE PUMP



DIODE PUMP ??

This circuit is NOT A DIODE PUMP. It needs another capacitor to "jack-up" the incoming voltage:

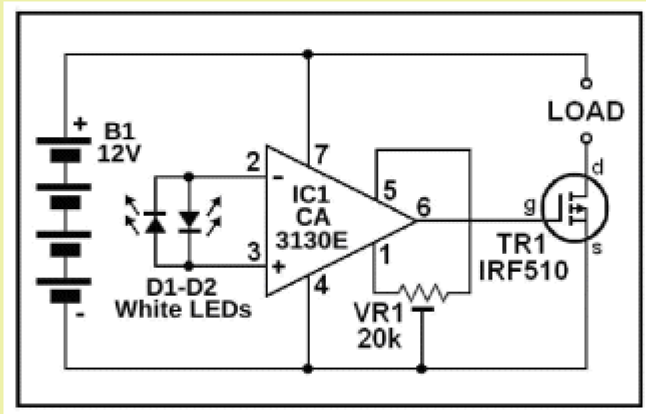


DIODE PUMP CIRCUIT

MOTION DETECTOR

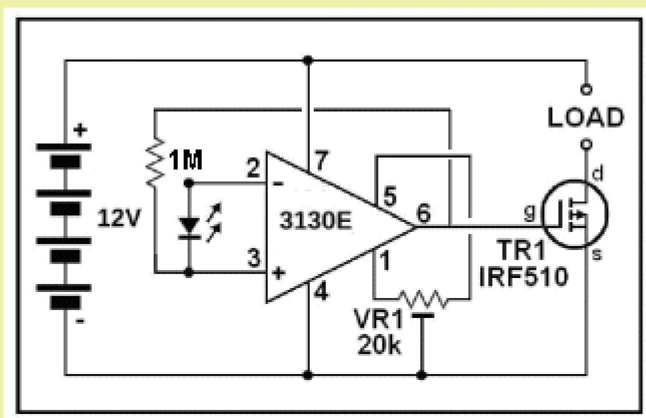
This circuit does NOT WORK. An op-amp does not work by simply putting a voltage between the input pins.

The inputs have to be biased via a resistor - either from the supply or from the output.
White LEDs NO NOT WORK.



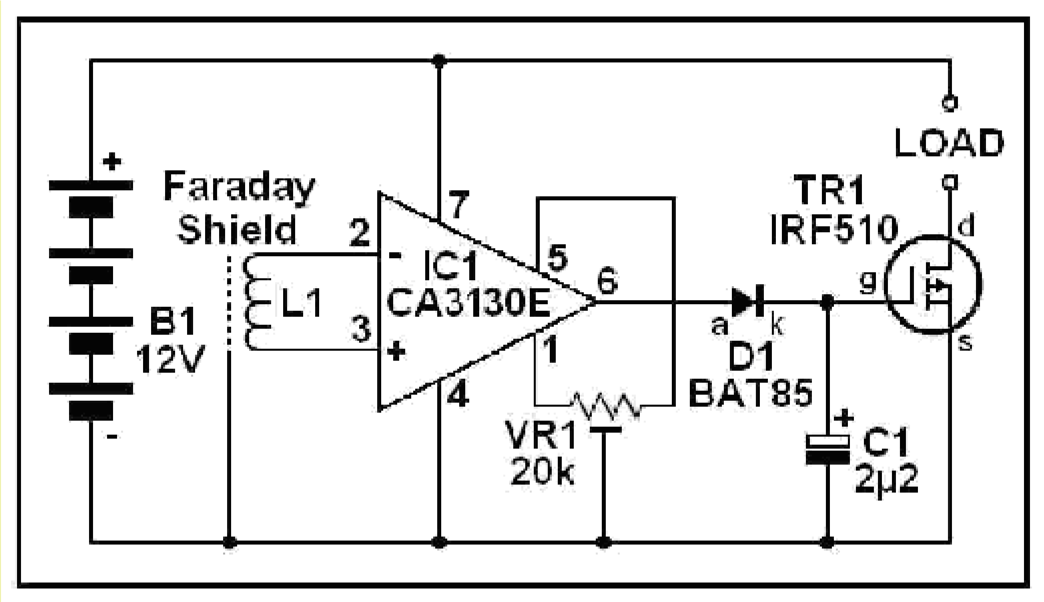
MOTION DETECTOR CIRCUIT

Here is the correct circuit. Almost any op-amp can be used and the feedback resistor can be from 100k to 2M2 - it does not make any difference.
Red LEDs and White LEDs **DO NOT WORK AT ALL**.
Green LEDs are quite sensitive but orange LEDs are very sensitive and super-bright orange LEDs are extremely sensitive. Only one LED is needed.
Op-amps tried in this circuit include 741 and LM348. LM324 was not as sensitive.



MOTION DETECTOR CIRCUIT - IT WORKS!

MAGNETIC KEY

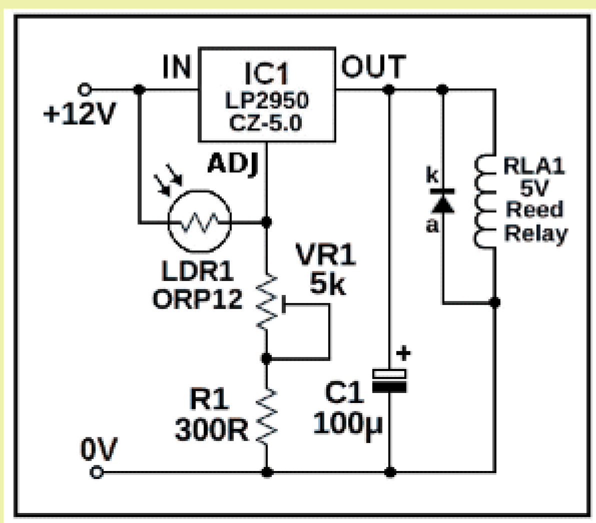


MAGNETIC KEY CIRCUIT

This circuit does not work for the same reasons described above. The inputs have to be biased. If the circuit does work for a CA3130, the author should have tried a number of other op-amps to see if the circuit is universal. By adding the feedback resistor (biasing resistor) the inputs are biased and a number of op-amps worked successfully.

That's why I design most of my circuits using commonly available components such as BC547 to indicate the type of transistor is not important. The same with 555. Just the normal 20cent item will work.

VOLTAGE SWITCH



VOLTAGE SWITCH

A light dependent resistor (LDR) causes the voltage at the control pin (ADJ) to rise as darkness falls, causing IC1 to switch "on" and to close a reed relay.

INCORRECT

The voltage on the ADJ pin **FALLS** when the LDR does not receive illumination. The circuit has never been tested and the writer cannot "see" how it works . . . otherwise he would not make this fatal mistake.

The output voltage changes from about 12v to about 5v as the illumination changes from bright to dark.
How is the reed relay going to turn on and off ????? If it is a 5v reed relay, it is still energised at 5v !!!!

If a thermistor (say 20k) is wired from the adjust pin (ADJ) to 0V, and if a suitable resistor is wired from ADJ to +VE (say a 50k preset potentiometer, then the regulator will switch with rising temperature.

What does he mean by SWITCH?

Where a regulator's control voltage (COM) is gradually reduced below the minimum voltage required, in some cases the regulator will suddenly switch off. This is true of the micro-power LP2950CZ.

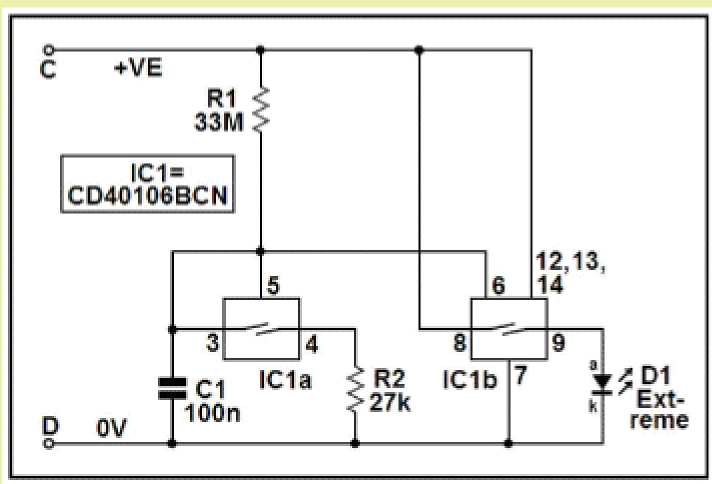
This is TOTALLY FALSE. I don't know where he gets this rubbish from. The **LP2950CZ** is simply a 3-terminal regulator with very low stand-by current and less than 500mV required across it when operating. The output can be "jacked-up" by increasing the voltage on the ADJ pin as the regulator maintains 5v between ADJ and OUT pins.

COMPONENTS:

Most of the op-amps cost about $1.00 but the postage is exorbitant:
Mouser Electronics have op-amps for $1.08 plus $39.00 postage !!!!!
Altronics have a minimum order of $20.00
DigiKey have op-amps for $1.08 plus $34.00 postage !!!!!
RS Components have op-amps for $1.0 plus $10.00 postage.
The cheapest components stockist is: TAYDA ELECTRONICS. Postage is $1.00 to $5.00
EBAY is also a good source for components where postage is generally FREE. You cannot beat the Chinese!
(The Chinese, Japanese, Taiwanese, perfected the car, the transistor and electronics in general. Of course it had a lot to do with advancement in technology, but their attitude of making something last a long time and fixing a fault, made them the leading edge in consumer products.)

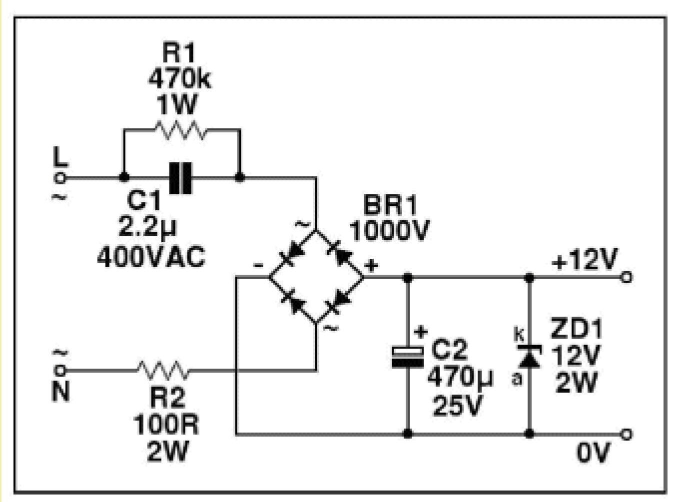
FREE ENERGY FLASHER

The IC should be CD4016 NOT CD40106.
The circuit is drawn incorrectly. The LED is connected across the 9v supply when the gate between pins 8 and 9 closes and the circuit is supposed to flash the LED from the charge on the 100n.



FREE ENERGY FLASHER

CAPACITOR-FED POWER SUPPLY:



CAPACITOR-FED POWER SUPPLY

The bridge is around the wrong way!!!
The author claims it will provide 20mA from 240v AC supply.
This is INCORRECT. It will deliver 130-150mA.
How can he be so inaccurate? Simple. He has never built a capacitor-fed power supply.
One of the dangers of describing something you know nothing about is a mistake like this. A 2u2 means nothing to him. Whereas I have designed many power supplies and each 100n on the input represents 7mA on the output.

The book has not been proof-read at all, with lots of spelling mistakes and sentences missing:

The winding of the coil is by no means critical, and a great deal of latitude is permissible. See the BFO METAL DETECTOR for instructions on the winding of the coil, which are the same as for this circuit. The *diameter* of the coil may also be changed, as described there, ????????????? no further sentence included in the book.

This circuit is therefore used to *pulse* the LED - in this case with a one-third duty cycle (the LED is "on" for only one-third of the time). And if the LED is "on" for only one-third of the time, **hen** of course there is a considerable power saving.

A number of circuits have the wrong IC identification: 40106 instead of 4016. Some circuits have no IC identification.

There are lots more mistakes in the eBook. The symbol for a bridge at the end of the book is also labelled incorrectly, The resistor colour code at the end of the book has an extra band which I have never seen on any resistor (this will just confuse the beginner),
The eBook says you can get a shock on 18v DC. In fact you cannot feel up to 200v DC. But 100v AC will throw you across the room.
Another technical mistake: The solar panel may be about 5 watts upwards. While a larger panel (say 25W) will not provide more power, it will mean longer charge time.
Should be: While a larger panel (say 25W) will provide more power and will mean a **SHORTER** charge time.
The eBook states: 500 Watts means 500 Watts for one hour, or 1 Watt for 500 hours.
No it doesn't. 500 watts can mean 500 watts for 5 minutes or 10 hours. It's like having a small radiator ON for 5 minutes or all day.

"10 Watts is ample for most relays" Relays are never rated in WATTS. A relay has a maximum voltage and maximum current for the contacts. You **CANNOT** convert these two values to **watts**.

Many CMOS gates (particularly Schmitt gates) switch as potential at an input crosses one-third or two-thirds of the supply voltage. ????? Should be: The output of many CMOS gates (particularly Schmitt gates) change from HIGH to LOW or LOW to HIGH when the input crosses one-third or two-thirds of the supply voltage.

If magnetic field lines approach a conductor at 90°, a current is generated in the conductor. Further, the more turns that the conductor has, the larger the current that is generated.

Untrue.

A larger VOLTAGE is produced with more turns. The CURRENT produced depends on the strength of the magnet.

As with all these eBooks and faulty websites, the authors immediately come back with a burst of comment "I will sue you for copyright infringement."
Firstly, they know nothing about copyright law.
You are permitted to copy any work up to 20% and even a greater content when the reproduction is for diagnosis, comment and correction.
In fact a whole work can be copied and released with all the mistakes and comments shown in red as this is excluded from copyright law.
I have been involved in copyright law for the past 30 years as Technical Schools were copying my books and handing out pages to students.
The copyright Agency in Australia then put counters on all copying machines in schools and charged a few cents per copy. The school had to write down the author of each photocopy. Suddenly I was sent a cheque for over $1,200 from the Copyright Agency. As each year passed, this dwindled as fewer and fewer schools abided by the requirement and finally we were sent a percentage of the takings.
That's why I am well versed in Copyright Law.
But it just proved the percentage of copied works, compared to original sales, is enormous. And it is just as relevant today as every book and magazine is available for FREE on the web.
When you download many of these titles and glance through them, the content is so poor, you delete the file and save $15.00.

In this day and age of being able to produce a full-colour eBook at no additional expense, it is disappointing that no photos of any project have been included in the eBook "**6 Or Less**." A digital camera only costs $10.00.

The faulty comment made on solar battery charging makes me wonder how much the author understands.
I go back 20 years to an article written by the technical editor of ELECTRONICS AUSTRALIA magazine.
He made a mistake about the charging of a battery and got an enormous response from readers.
So much so that he never wrote for the magazine again.
The mistakes made in this eBook fall into the same category.
You cannot afford to make one single mistake in electronics - especially when it is going into print.
There are lots more typographical mistakes and the first response from the writer should have been the inclusion of an amendments sheet in the books that have been published and a set of corrections to the eBook.
I offered this suggestion and characteristically got no reply.
This is another eBook that I would not recommend as you don't know where the mistakes are located and since there so many of them, you will be led "down the garden path" with so many circuits.

The advertising spiel states: "More than 150 fast, easy, wow electronic projects." There may be 60 circuits and the rest are just comments and adaptations of the same circuits. This is completely false advertising.
Another false comment is: Designed with backwaters of the world in mind: Cape Town, La Paz, Jakarta, Kolkata, and many wonderful places which may not be that well stocked with components.
But he has used all sorts of odd and difficult to purchase components. He has obviously raided his "parts box."
Some of the components will be impossible to find: BAT 85 diode, UN66-xx melody chip, Solar Motor?? PICAXE-08 chip, Piezo Sounder ????, 2N2646 Uni-junction Transistor, 6.8v 5 watt zener, 0.01F supercap, 20M 1/8th watt resistor, 100n tantalum, 1M multi-turn pot, ICM7555IPA chip, 15M 1/8th resistor, 5v reed relay, ICM7556IPD IC, 100p tuning capacitor, crystal earpiece, 10mm ferrite rod, and others.
Many who live in these outreaches of the world could not afford to buy the book and they cannot purchase overseas, anyway, so it's pointless mentioning this feature.

All the projects I design are backed by a kit of parts so no-one is left stranded with a design that cannot be built.
I also provide a contact address and email so anyone can get further details on a project.

Thomas Scarborough requested a right of reply, which I acceded to. But in his last email he went on with some irrelevant drivel and it is clear he is not capable of confronting any of the points I have brought up.

This is the sort of thing that makes me exceedingly angry.
It is a simple matter to correct the mistakes in a .pdf file. Any spelling or omissions in any of the .pdf's on my website are corrected immediately. I don't now how a technical writer can live with the knowledge of having faulty circuits being circulated to hobbyists.
This shows the contempt Thomas Scarborough has for the electronics experimenter. He produced a book with lots of mistakes and then washes his hands of the responsibility to correct the mistakes. This eBook has the highest number of mistakes on record and the worst descriptions.
If you think I am over-reacting, just wait until you use a piece of inaccurate information and spend days going down the wrong path. This has happened a few times with data sheets and you tend to double-check and triple check everything you find on the web to prevent a problem arising again.

Thomas Scarborough emailed me to say the book is into its fourth edition and has been checked by top electronics experts. He goes on further to name a few of the Technical Experts: Many if not most of the projects are from published articles, and the proof-readers include such luminaries as (the late) John Becker, Jim Rowe, Alan Winstanley, Leo Simpson, and Dan Danknick.
I think they would be HORRIFIED if they knew they were mentioned as having proof-read the book or had any part of checking any of the content AT ALL.
This section of the website was a result of informing writers of the mistakes on their site and either getting NO COMMENT or failing to fix the mistakes.
I then decided to put the mistakes on my website and now the content has grown to more than 19 pages.
With 100 visitors reading these pages each day, it is reaching 30,000 readers each year and been on the web for nearly 10 years.
Remember, only one in a thousand electronics hobbyists want to know and understand the fundamentals of electronics and these pages are the first time any writer has explained HOW and WHY a circuit does not work.

I remember employing a University graduate to build and design an oxygen detector for a furnace, some 30 years ago.
He designed the PC board with tape and we had a sample made.
I bought all the components and he soldered them to the board.
When he put the chips onto the board he had to bend all the pins backwards and when the displays illuminated, all the incorrect segments lit up.
The next morning he didn't turn up. I waited 'till 9:30 and rang him at home.
He said: "Stick the project up your arse."
That's because he was told: "University students don't make mistakes!!"
It all comes from the absurd assessment of students. To get a score of 99.98% over a range of 6 subjects, is totally stupid. It gives the student a feeling that anything they do will be successful. This extends to their attitude when designing a circuit.
They think: "Anything they design, WILL WORK."
The first thing they design after leaving University does not work and they throw up their hands.
I had a second incident of "University Attitude."
A "Careers Broker" rang me to say he had a University student interested in writing articles for Talking Electronics Magazine.
"Send him along." I said.
Oh, no. We charge $350 for a placement. (That was 2 weeks wages.)
I don't pay for placement.
3 weeks later they rang again and said they would send the applicant FOR FREE.
I contacted the applicant and said I would send him a set of parts and he could build and describe the project.
"Oh, I don't do soldering" was his reply.
I never-again employed a University student. They simply have the wrong attitude. University was free in those days but it took 3-4 years of study. They all felt they DESERVE EMPLOYMENT and they all felt they could NEVER MAKE A MISTAKE.
With scores like 85% - 95%, they think every circuit will work first-time. If that were true, every electronics engineer would be a millionaire.
They only build circuits at University that work and test the parameters. What an absurd way to go through a course.

As you can see, it is much more complex to produce a book of circuits, than you think.
Every circuit has to be built by someone else to make sure it works.
That was one of the first rules of Talking Electronics.
One of the staff built each project as soon as the PC boards arrived.
But to publish a book without any form of testing or poof-reading is madness. Nearly half the circuits in the eBook are faulty or have misleading text. This is possibly the worst book of circuits I have come across.

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SPOT THE MISTAKES!

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Although the web is wonderful, it is filled with too many sites that offer no information other than links to other sites and masses of dead-ends.
In the process you are confronted with irrelevant advertisements.
On top of this are the sites that stat with a lot of fan-fare and rapidly fizzle into nothingness.
I recently tried to find sites offering a Basic Electronics course, as I thought this had been fully covered.
I was asked to review a book: **COMPLETE ELECTRONICS SELF-TEACHING GUIDE** with Projects by Earl Boysen and Harry Kybett.
Not only did I find the book completely lacking in some of the most basic circuits and topics, there were innumerable mistakes and complexities that should have been removed from a "basics book."
After an enormous amount of searching on the web, I came to the conclusion that this area had not been covered to a level that a teacher could send a student to a single website and learn about basic electronics.
That's why I wrote the eBook "Basic Electronics 1A."

The quality, complexity and completeness of the internet is so valuable and fulfilling that it will very soon become the teaching facility of the future.
It just requires a little more sorting and co-ordination to get all the relevant material into sections so the reader can progress without having to sift through redundancy, while getting all the important facts.
It may have been suitable in the last Century to have schools and Universities with hourly lessons and lectures but with the advent of the internet; the time, energy and expense travelling to and from classes can now be saved by using the internet to deliver the information.
I know Universities are baulking at this proposal because it is showing their gradual

redundancy, but the web will over take conventional centres of learning.
It is already happening. Lots of mediocre and meaningless University degrees are already available on the internet and some sections of technically-advanced courses are available.
Practical-work will still need to be done and possibly some of it can be done with kits through the postal system.
For a $20,000 course, you can get a lot of technical material.
Who would have thought the teaching profession would become redundant????
This is going to be the next big change in education.
Students will acquire their training through the internet and attend blocks of practical work and final examinations.
"On-line" degrees will have to be accepted.
This is the way of the future.
Who would have thought GOOGLE would make all this successful ????

These pages of SPOT THE MISTAKE are the most important pages you will ever read.
How do you think I got my intensive understanding of electronics?
By repairing electronic equipment.
Some circuits work for 5 years then stop working.
The best thing to test the circuit is a damp finger. Push your finger against all the pads on the bottom of the board. It will detect if a resistor has gone open or an open capacitor. Then probe around to see if a joint has become faulty.
You learn much more when repairing a circuit because you have to "see" how it operates.
And that's what these pages are doing. They show you how to "see" a fault and how to correct it.

Here's another disastrous circuit from **Electronic For You** Magazine (January 2014):

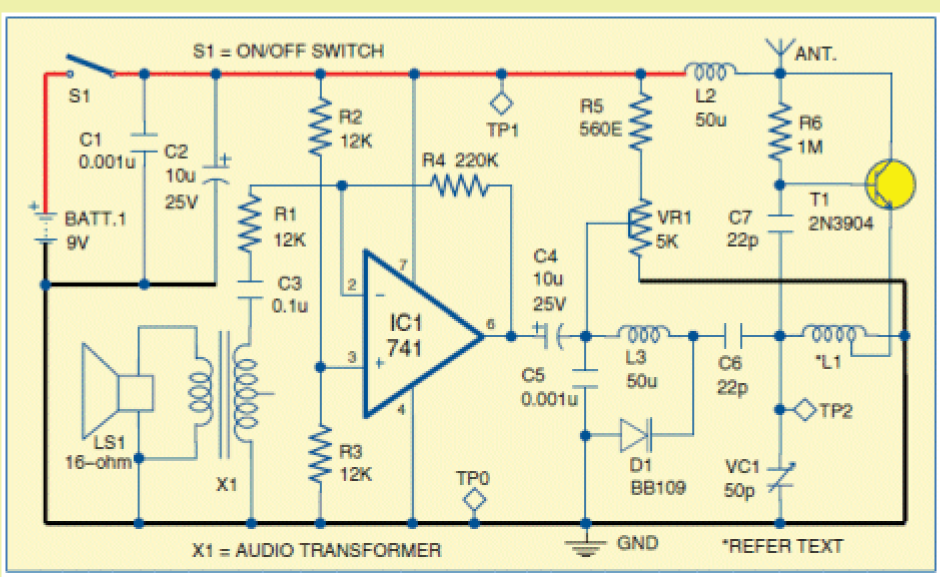
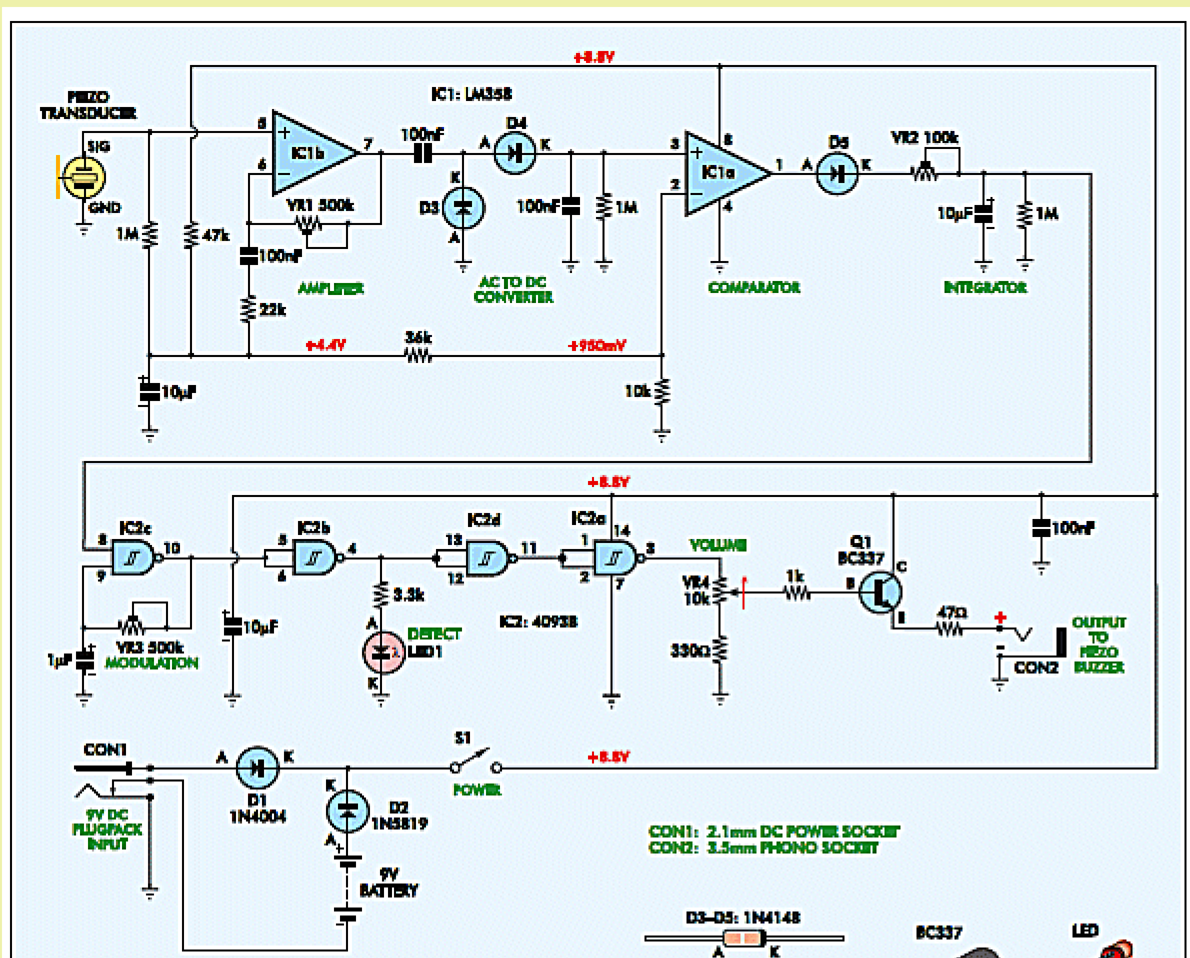


Fig. 1: Circuit diagram of the wireless FM microphone

See our section on Spy Bugs and FM bugs in the left index on the front of Talking Electronics website to see how a simple FM Bug can be built. All our bugs work perfectly and over 100,000 kits have been sold.
Before designing a project, you should look on the web and see what has been done. It is pointless designing a circuit that is more-complex than pervious designs. The skill is making a simpler circuit or one that works better than anything presented previously.
Here is a typical disaster from EFY.
It uses a 16 ohm speaker as the microphone. No only is it larger than an electret microphone but it is less sensitive. Why include a transformer when a 741 op-amp will amplify the slightest waveform??
Two transistors could replace the transformer and op-amp and take up less space on the board.
The rest of the circuit is very complex and simply specifying an inductor as 50uH is not sufficient. The name of the manufacturer and the current capability of the inductor is also needed as some inductors will work and others will be very poor. The size and shape of the 4-turn coil L1 is very poor. The turns of a coil should be spaced no more than the thickness of the wire for good inductance whereas this coil has very widely spaced turns.
Overall a disastrous circuit with twice the number of components as our designs and very poor sensitivity with a speaker as a microphone.

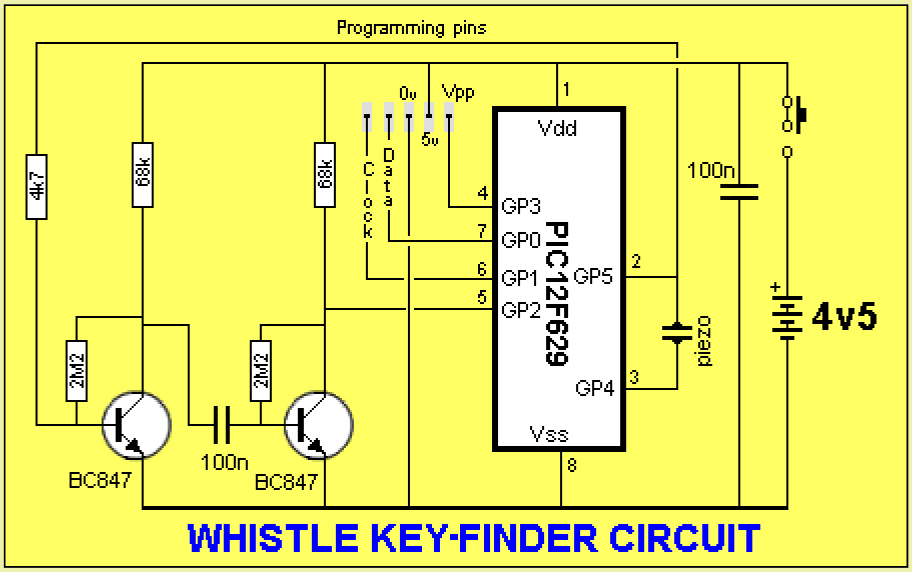
LOUD PHONE RING



MOBILE PHONE RING EXTENDER
Fig.2: the circuit is based on two low-cost ICs, a dual op amp (IC1) and a quad Schmitt trigger NAND (IC2). It can be operated from either a 9V battery or, for longer term operation, a 9V DC plugpack.

Here we have a circuit from **Everyday Practical Electronics** February 2014 that has be reprinted from **Silicon Chip** February 2013.
The past few years of **Everyday Practical Electronics** has been filled with reprints from **Silicon Chip** and no new projects have been delivered.
This might be good for **Silicon Chip** with re-write revenue coming in, but is certainly not in the best interests of the hobbyist.
A hobbyist will have already seen these projects (as I have) and it's just a re-gurgitation.
But the main point of the project is the complexity. The op-amp could be replaced with a couple of transistors and

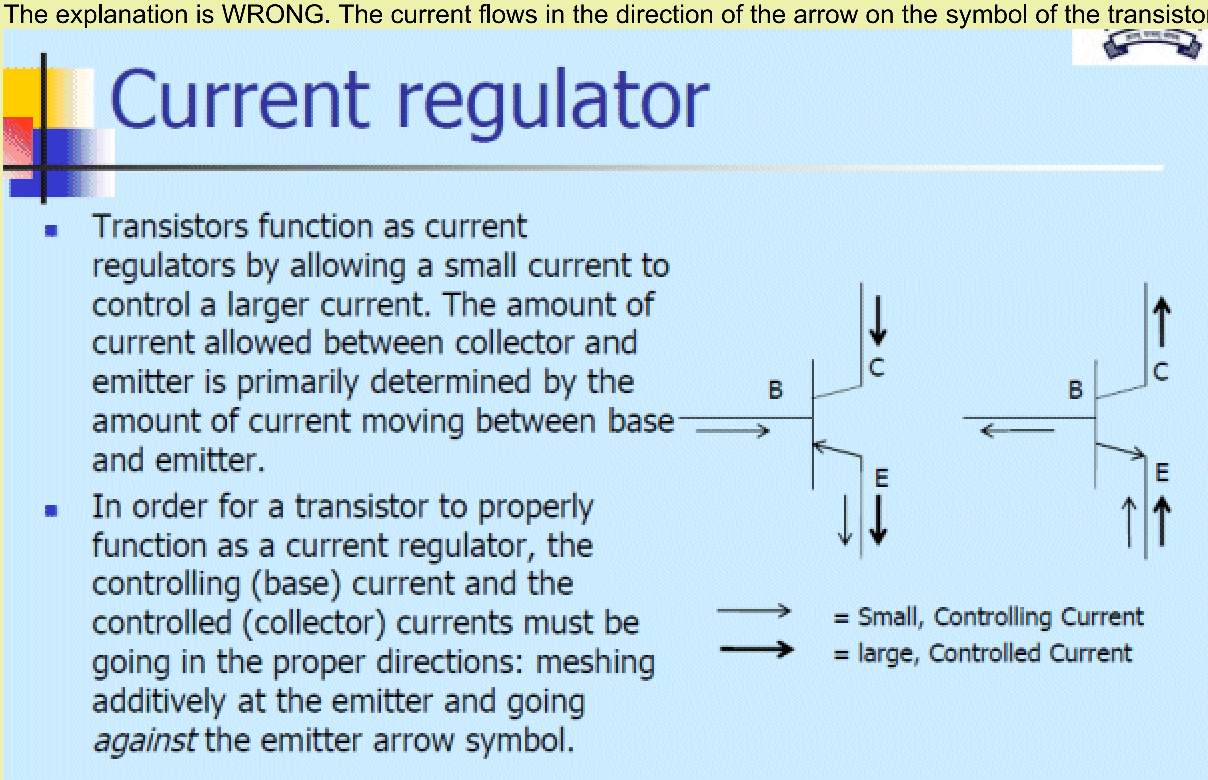
if you want to really condense the circuit, it could all be done using an 8-pin microcontroller, as shown in our project **Whistle Key Finder**:



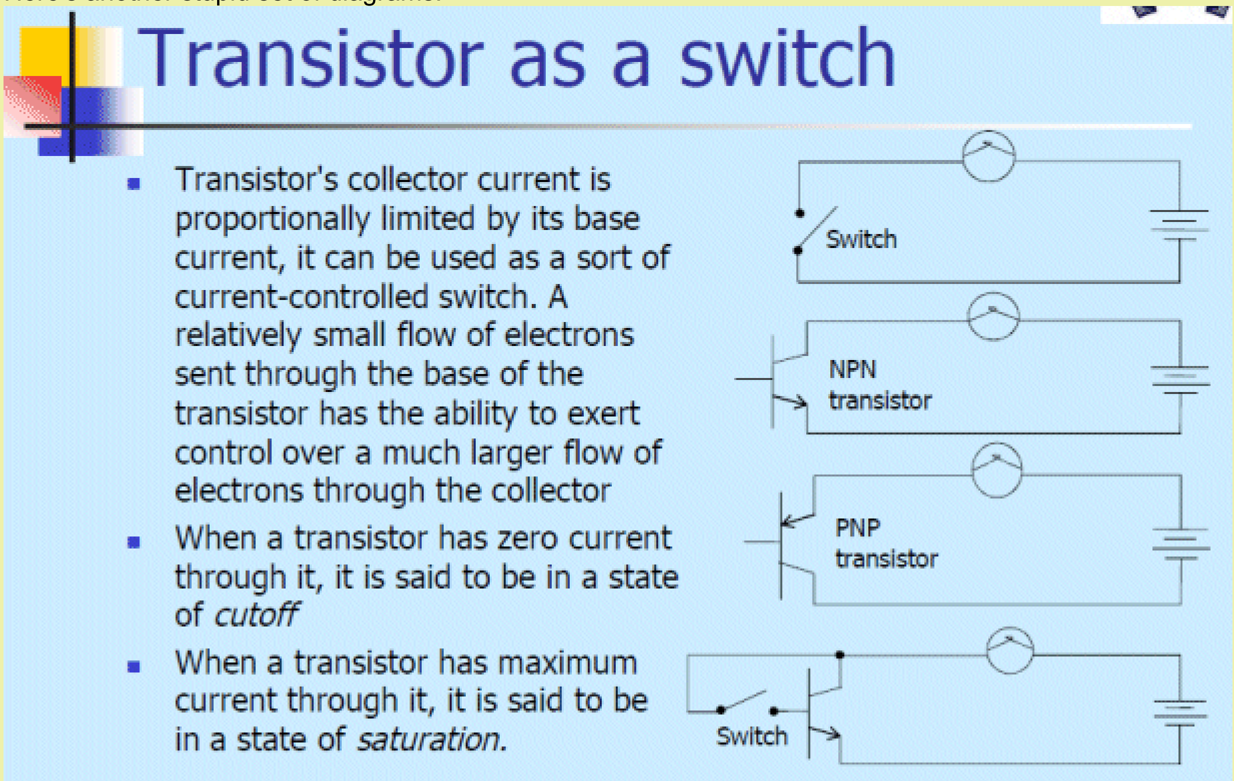
The whole idea of producing a project is to show the latest and best way to design a circuit. The skill is to keep it simple with costs as low as possible. The **Whistle Key Finder** only needs one transistor amplifier stage and a buffer output to drive a loud piezo siren with a built-in oscillator. The piezo diaphragm is connected directly to the base of the single transistor input stage. The micro does all the work.

Here's another Indian Professor and his set of Lecture Notes.
The descriptive English is absolutely TERRIBLE and I can hardly understand what he is trying to say. It is no wonder Indian students finish their courses with little understanding of electronics.
Here's a typical example of muddled thinking:

The explanation is WRONG. The current flows in the direction of the arrow on the symbol of the transistor:

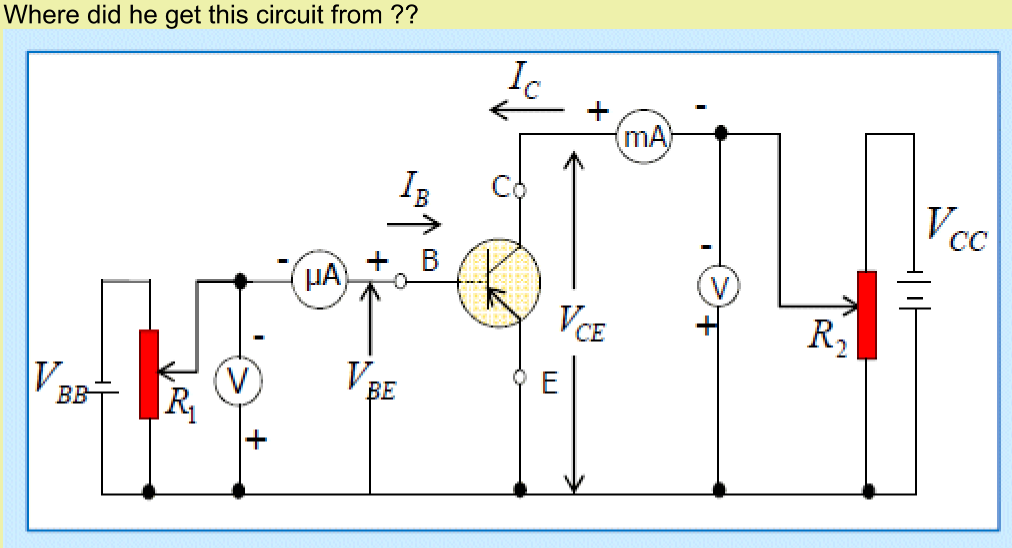


Here's another stupid set of diagrams:



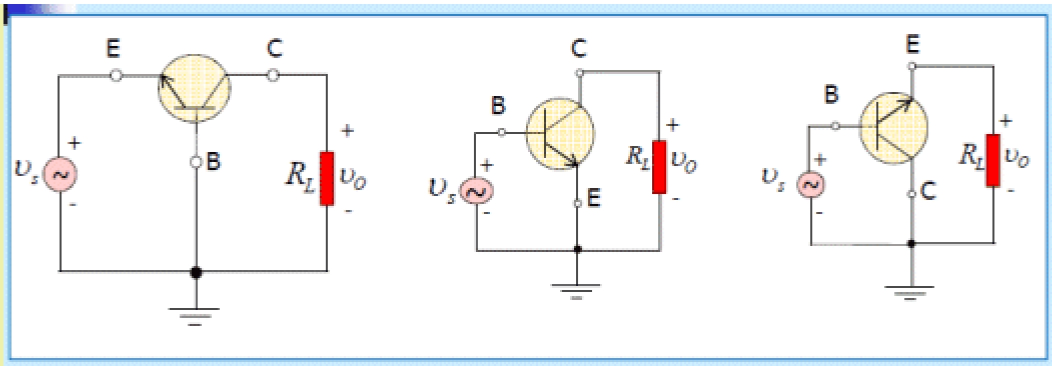
The current flowing through the transistor in the bottom diagram will flow through the base-emitter junction to turn the transistor ON and the voltage developed across the base-emitter junction will be set by the current flowing through the collector-emitter junction. The transistor will not be fully saturated as the collector-emitter voltage will not be as lows as possible (0.2v) but about 0.65v.

Where did he get this circuit from ??



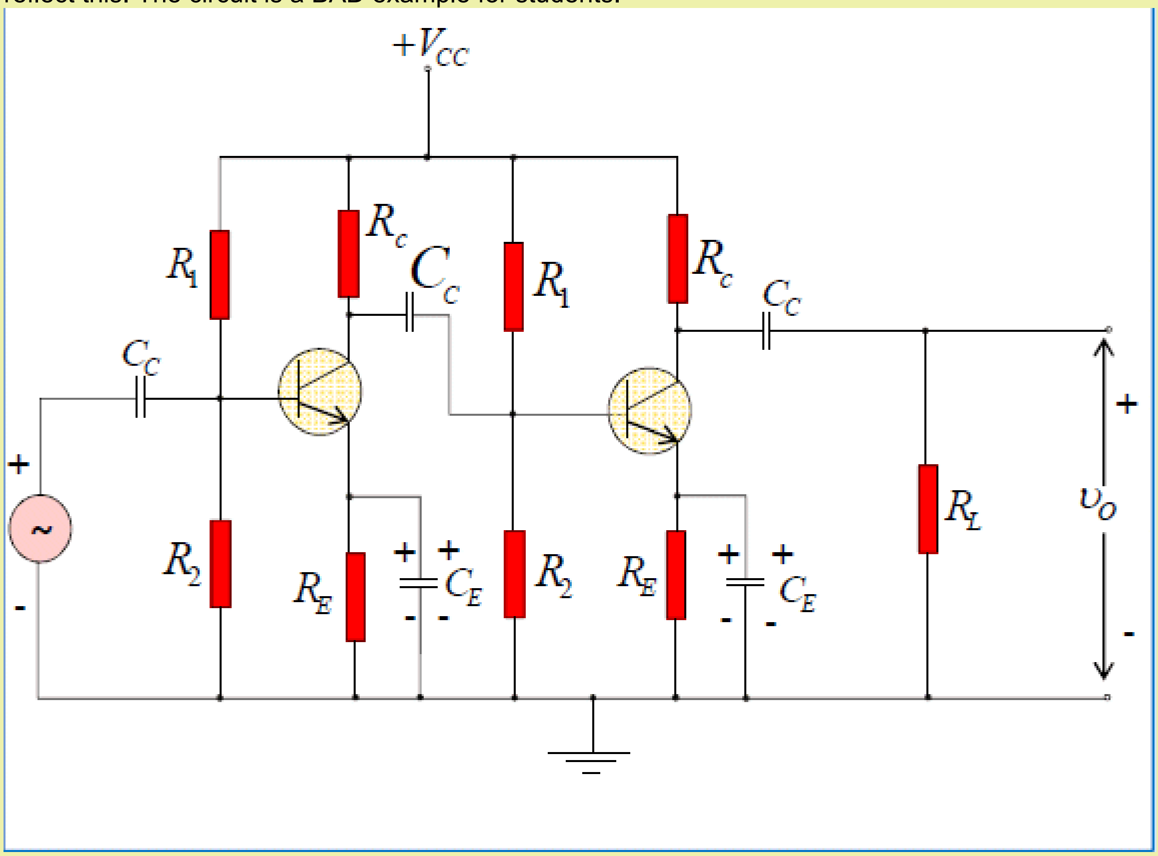
Show me one project using a PNP transistor with positive voltage on the lower rail. This is an absurd circuit to use in lecture notes. It has never been used in practice.

Here's another faulty diagram:

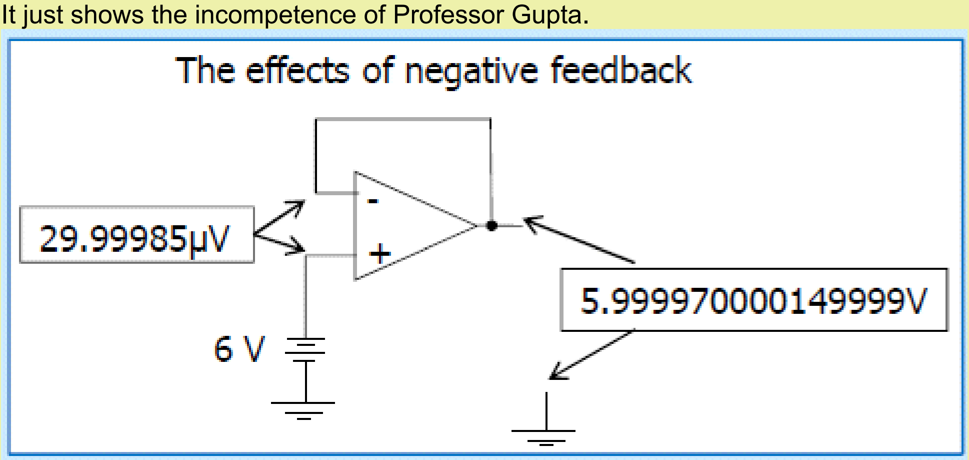


The third diagram has the supply voltages incorrectly drawn. How does a LOAD RESISTOR have a voltage across it ???

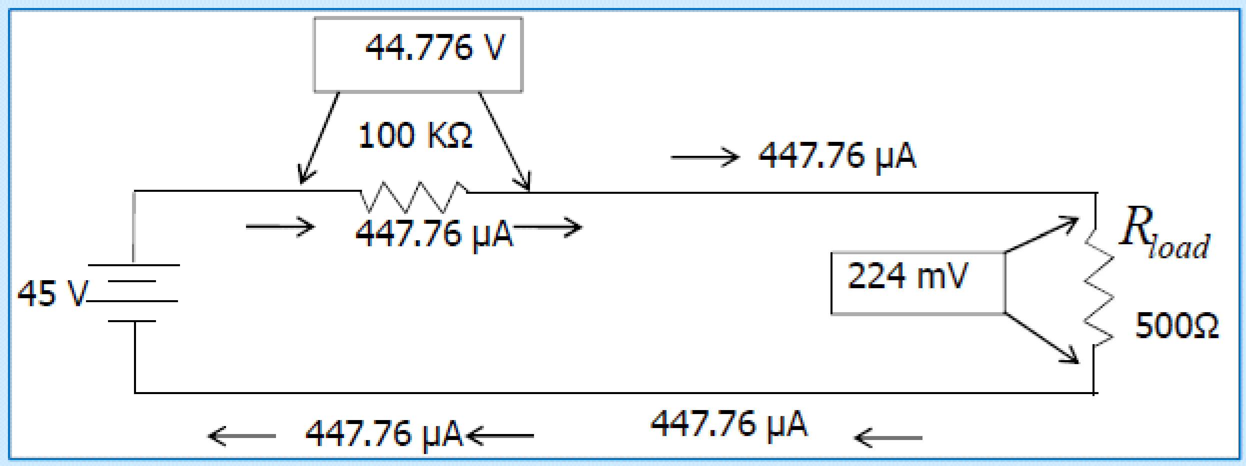
Professor Gupta has simply "copied and pasted" to get this circuit. There are two R1 R2 etc. In general, the second stage has different values because the current capability of the stage is greater and the components will reflect this. The circuit is a BAD example for students.



It is absurd to provide values to many decimal places as no instrument is capable of measuring to this accuracy. It just shows the incompetence of Professor Gupta.

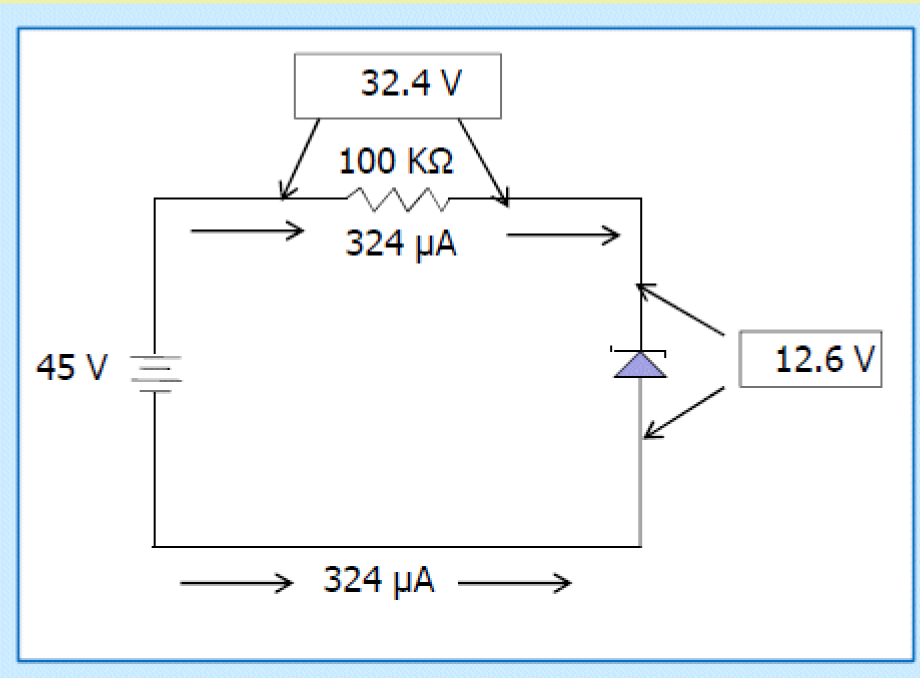


Here's a complete lack of understanding of the basic laws of computations:



The 100k resistor may have an accuracy of 1% and yet the "Professor" has given the current an accuracy of 1/100th of one percent. The answer cannot be any more accurate than the worst-given-data. And, in fact the voltage is provided as "whole volts" and the data cannot be more accurate than "whole amps."

How can the current flow in both directions at the same time ???



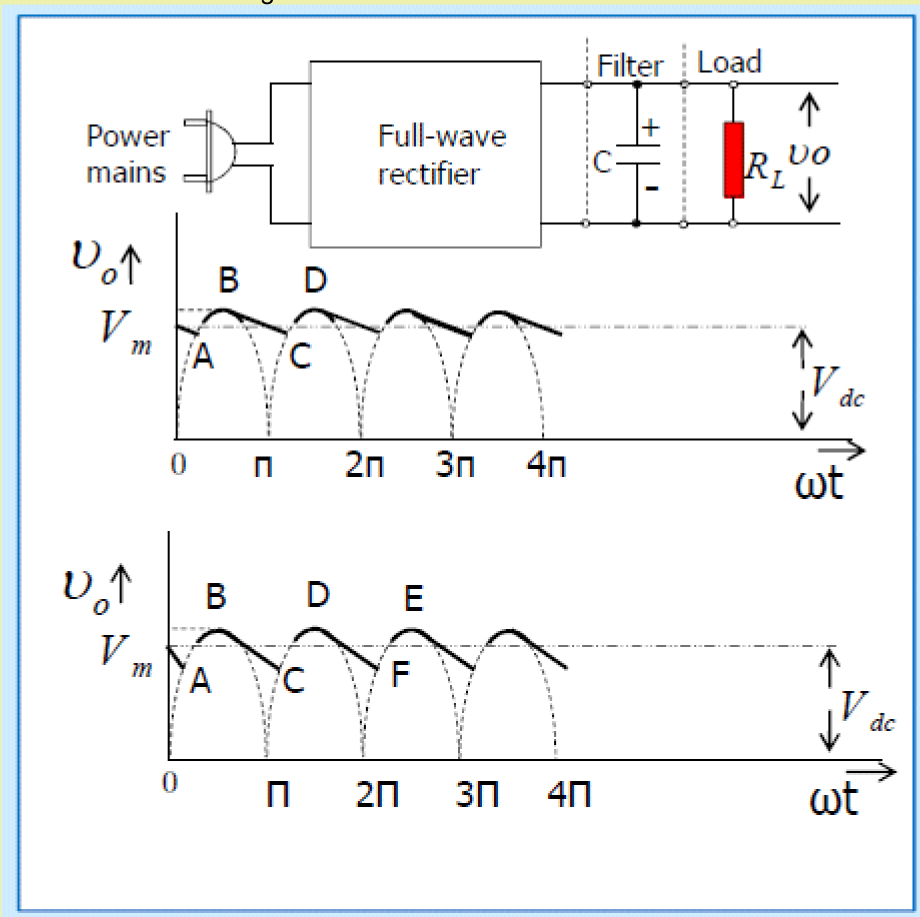
Another absurd result:

$$P_{resistor} = (324\mu A)(32.4V)$$
$$P_{resistor} = 10.498mW$$

$$P_{diode} = (324\mu A)(12.6V)$$
$$P_{diode} = 4.0824mW$$

How can you get 10.498mW when the voltage is only accurate to one-tenth of a volt ???

Look at this terrible English:



SHUNT CAPACITOR FILTER

Block DC, allow AC to follow - what does this mean ????
Large C gives less ripples ???? - NO. A large C reduces the AMPLITUDE of the ripple.

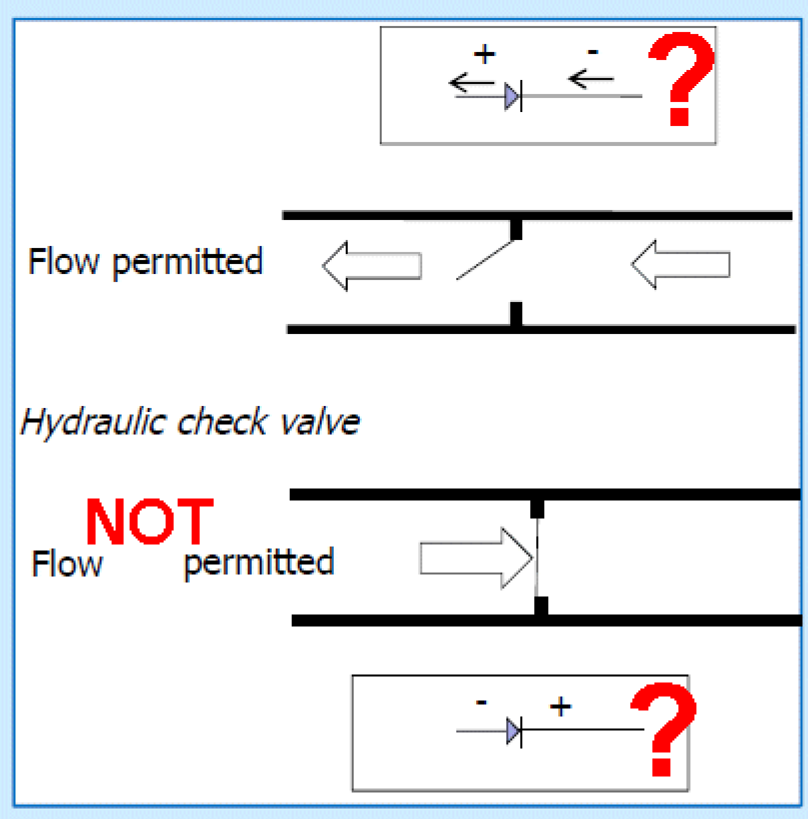
Rectification is the conversion of alternating current (AC) to direct current (DC).

Should be:

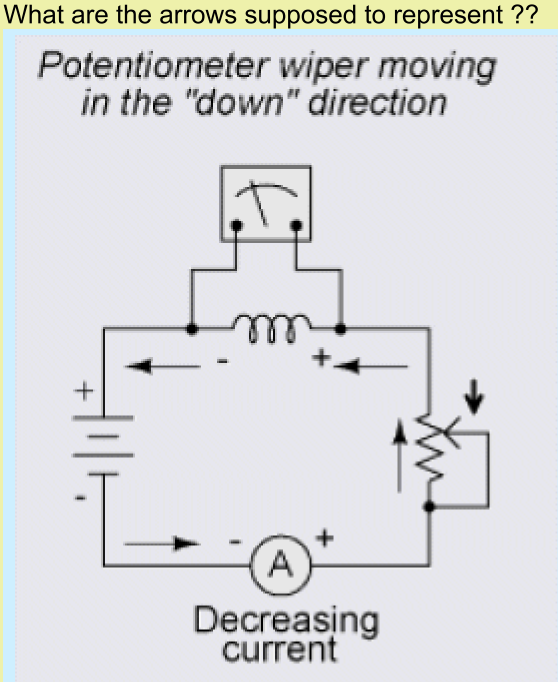
Rectification is the conversion of AC to DC

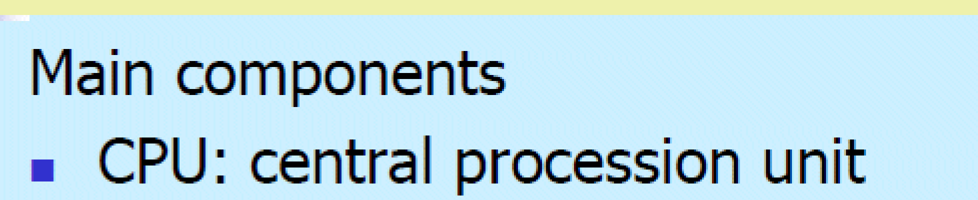
Although we say Alternating Current for the waveform delivered by the mains, we are really dealing with the voltage and this is why we say "AC." AC is another way of saying "Oscillating Voltage" Rectification changes the characteristics of the VOLTAGE and this is the parameter we are dealing with.

I have no idea what the "Professor" is trying to say:



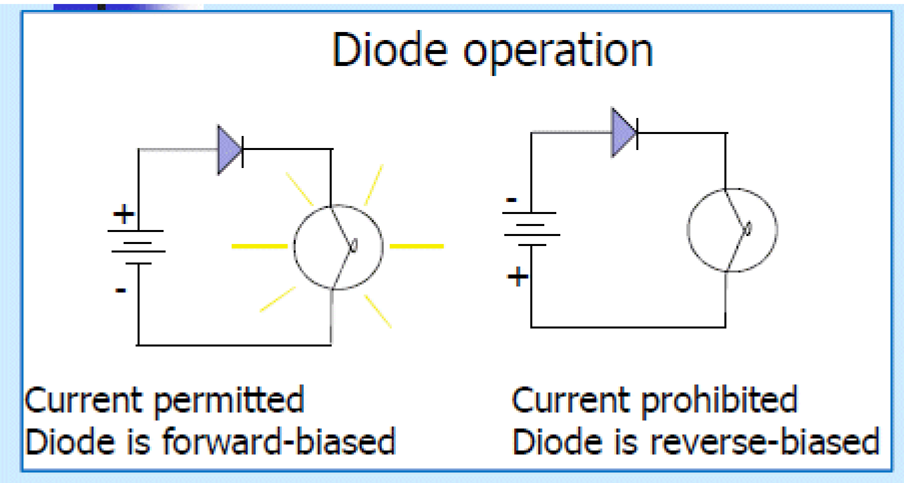
What are the arrows supposed to represent ??

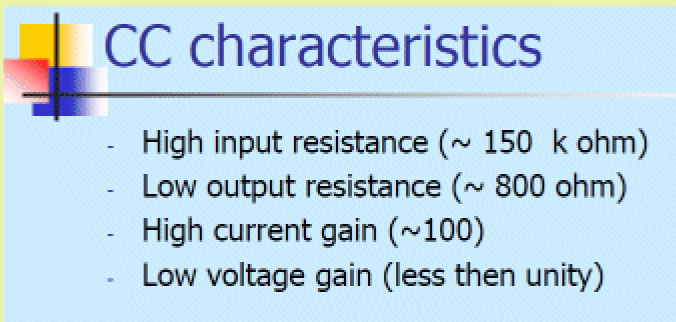




Should be **Central Processing Unit**

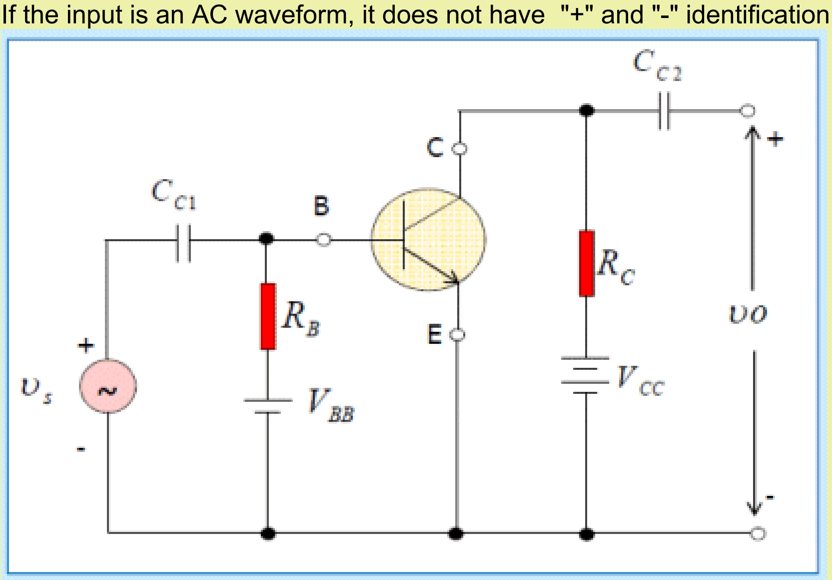
The battery symbol has not been reversed in the second diagram:



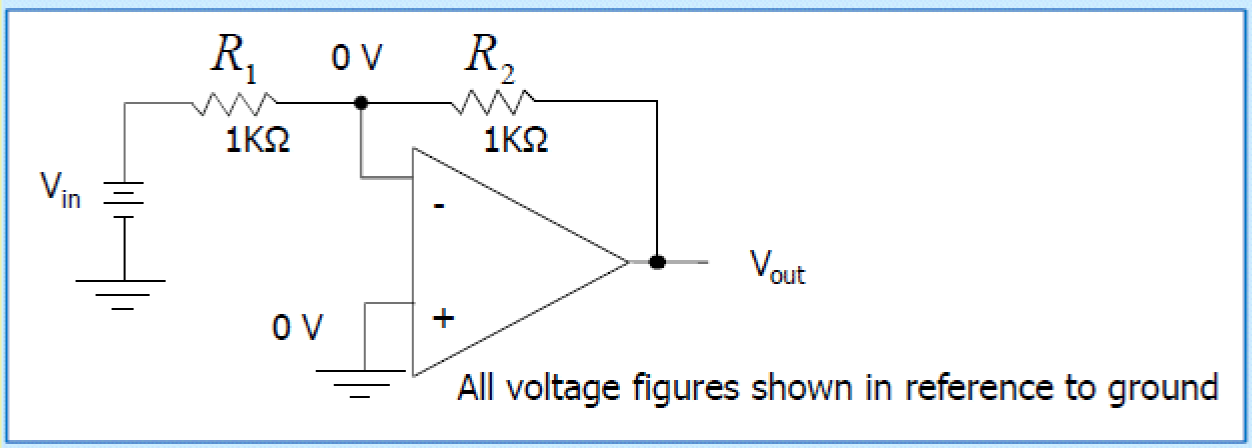


Common Collector Characteristics
Should be:
For a transistor with Hfe = 100, the input impedance is 100 x load resistance
Output resistance = LOAD resistance (can be 1 ohm to many kilo ohms)
Current gain 20 to more than 300 (depending on transistor type.
Voltage Gain = Less **THAN** unity.

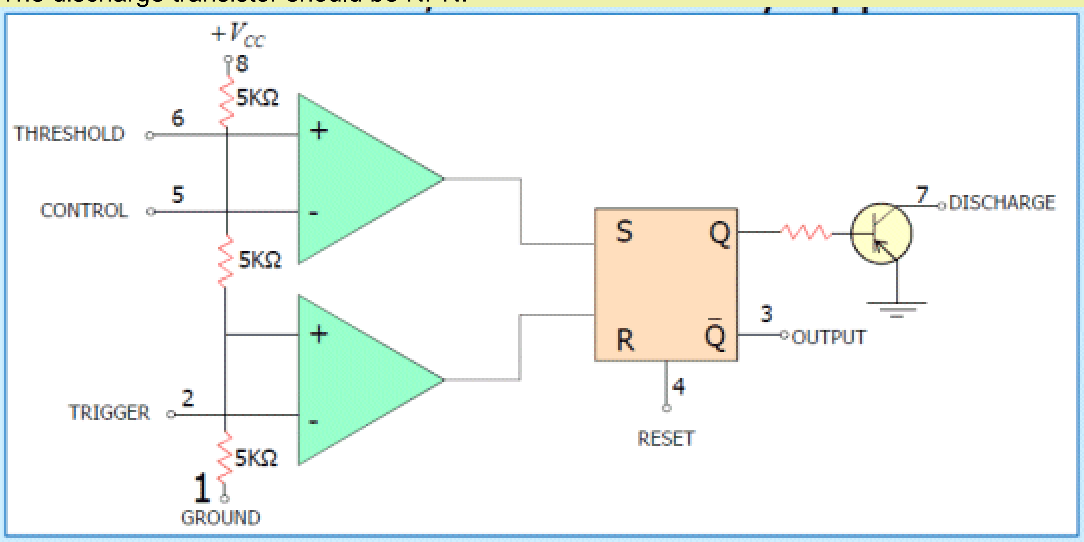
If the input is an AC waveform, it does not have "+" and "-" identification:



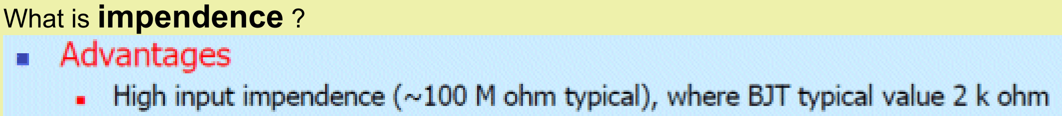
How can 0v be present at the join of the two 1k resistors ???



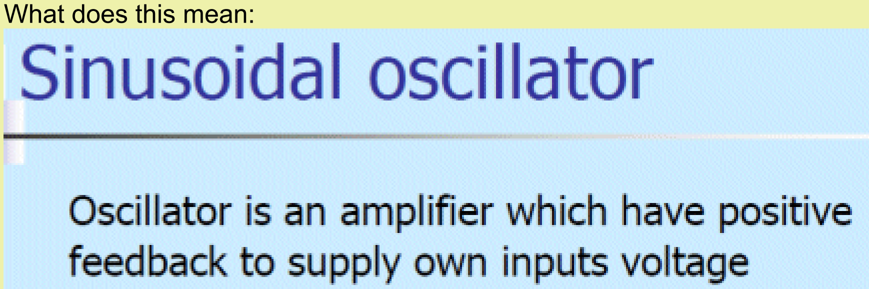
The discharge transistor should be NPN:



What is **impendence** ?



What does this mean:



This is only a few of the faults.

I emailed Professor Rajesh Gupta at Indian Institute of Technology Bombay and got this incredible reply:

Keep your comments with yourself we do not need it .

Professor Rajesh Gupta rajeshgupta@iitb.ac.in

Department of Energy Science and Engineering

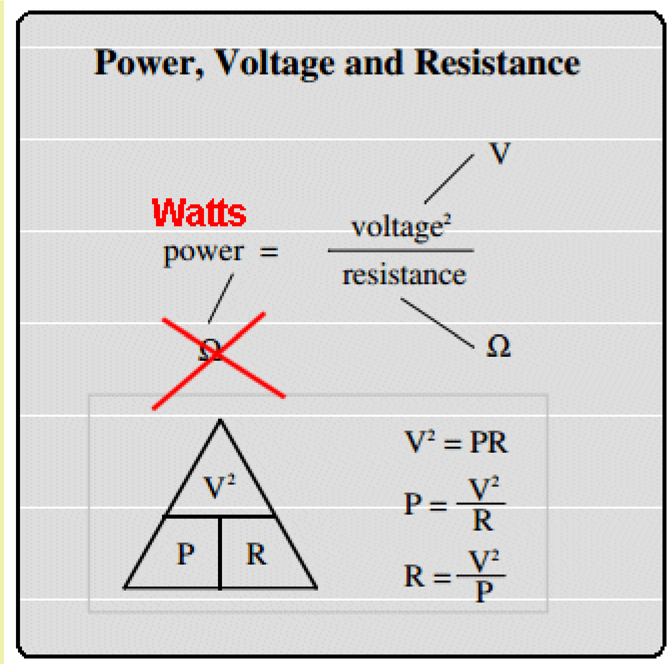
Indian Institute of Technology Bombay,

Here's a table from a set of lecture notes:

Characteristic	*CE*	*CC*	*CB*
power gain	yes	yes	yes
voltage gain	yes	no	yes
current gain	yes	yes	no
input resistance	3.5 kΩ	580 kΩ	30 Ω
output resistance	200 kΩ	3 5 Ω	3.1 MΩ
voltage phase change	yes	no	no

How can the input impedance of a Common Collector (Emitter-Follower) stage be 580k when the generally accepted input is the gain of the transistor (20 to 200) multiplied by the load resistance (in the emitter).
This type of stage is ideal for driving a low resistance LOAD such as 5 ohms to 200 ohms.
The transistor makes it 20 to 200 times "easier" to drive the load.
None of these "practical" points are mentioned in the lecture notes because they are written by someone who has NEVER actually constructed any of the circuits and merely cobbled together bland, uninteresting, poorly documented notes with a heavy emphasis on using technical terms and formulae that will take hours to process.
Instead of trying to work out any of the voltages and current in a particular design, simply build the circuit and you will find your theoretical values are WAY OFF. That's because a transistor is not linear and since the gain can be 100 to 250 in a batch of devices, you have no way of working out the correct values.
Secondly, no boss is going to allow you to sit down and compute the results at HIS expense and then find the results are 50% inaccurate.
Simply build the circuit on a matrix board and place the components in the same places as for the final design and you are doing three things AT ONCE.
You are building the circuit, making sure it works, getting a layout and size, determining the parts required and getting it ready for PCB designing as well as determining the current requirements.
That's why the dumbest workers are not always the most stupid.
I had one worker who could draw the entire circuit for a 10 watt audio amplifier at a moment's notice. That's what I call dedication.
If you look at some of the lecture notes and see transistors drawn up-side-down and negative rails at the top, you wonder why students come out of a 3-year course with little REAL understanding.

Here is a fault in a set of Lecture Notes: The corrections are in **red.**



More faults from Indian Lecture notes:

Zener diode is a diode that block current until a specified voltage is applied. Remember also that the applied voltage is called the breakdown, or Zener voltage. Zener diodes are available with different Zener voltages. When the Zener voltage is reached, the Zener diode conducts from its anode to its cathode (with the direction of the arrow).

Three faults:
A zener diode DOES NOT ALLOW current to flow until a specified voltage is applied.
The applied voltage is NOT called the zener voltage. The applied voltage is called the APPLIED VOLTAGE and when it reaches the zener breakdown voltage, current flows through the zener. Normally the applied voltage uses a resistor between the applied voltage and the zener to restrict the current through the zener and allow the zener to create the exact zener voltage.
When the zener conducts, current flows from CATHODE to ANODE.

Zener diodes are manufactured to have a very low reverse bias breakdown voltage

Zener diodes can be made from 3v to more than 50v.

You may understand by now that the inputs have no ability to set signals high or low.

Tim Sumner, Imperial College,

What does this mean ????

Outputs can draw current and can force lines to low or high.

To Mr Tim Summer: Outputs DON'T draw current. Outputs either sink or source current.

Counter-example: a *bad* power electronic circuit

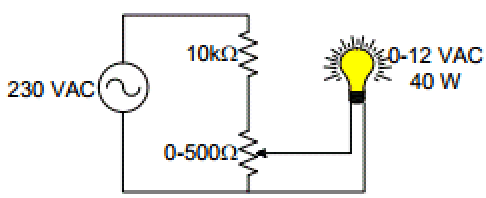


Figure 1. A 230V AV supply outputs power to a 12V light bulb -- but how much power is wasted?

Figure 1 (right): a 230V AC source supplying power, via a resistor network (including a dimmer switch), to a light bulb. The dimmer switch (the potentiometer) allows the voltage across the light bulb to be varied between 0 V and about 12 V.

The 10k resistor will only allow 24mA to flow. The globe needs more than 3 amps.
A terrible example to give a beginner.

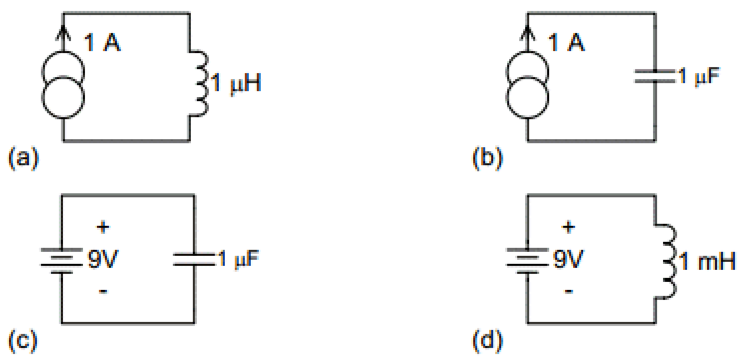


Figure 3. Sources, capacitors and inductors. Which are unstable?

Question 1.2: Which of the circuits of Figure 3 above are unstable?

What is meant by UNSTABLE?????? I have absolutely no idea what he is talking about.

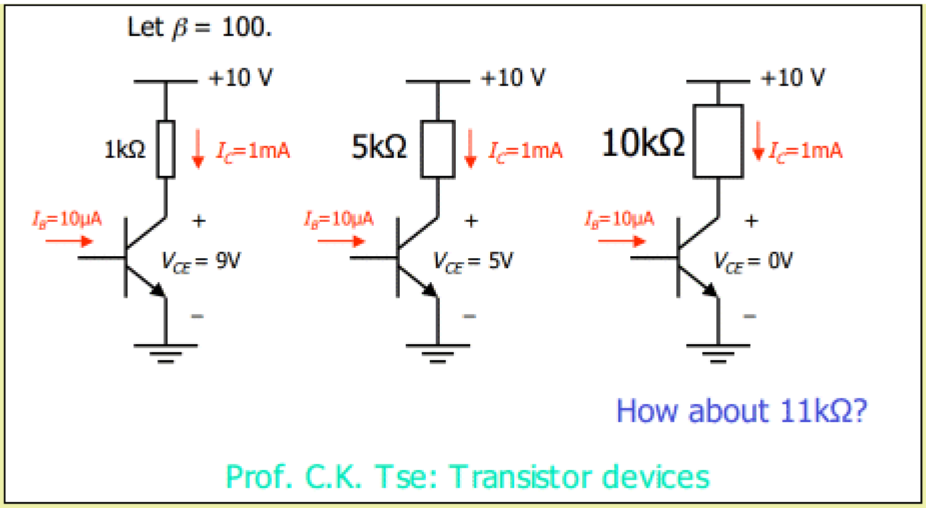
Here's the type of absurdity from an Indian who produces a website and boasts he gets one million visitors each month:

He has produced a page with dozens of questions but NO ANSWERS.
Here's his reply from a visitor:

Could you please tell me the answers to question asked in interview?
I don't plan to post any answers or reply to this kind of requests. Question are there for you to get a idea of how the questions would be in an interview.

Deepak Kumar Tala [**http://www.asic-world.com/faq.html**](http://www.asic-world.com/faq.html)

What is the point of annoying a beginner by posing questions and not replying ????



This is the sort of thing that ANNOYS ME. The most important part of the discussion is to answer the question: How about 11k?
The answer is simple: The transistor is fully turned on with 10uA into the base and the voltage across the collector-emitter leads will be 0.2v when any current up to 1mA flows. With 11k load, the current will be slightly less than 1mA and Vce will be 0.2v When the current is more than 1mA, the transistor stars to turn off slightly and the collector-emitter voltage increases.

OR GATE

How does this circuit work ???? This is supposed to be an OR-gate for a beginner !!!!! It's not an OR-gate.

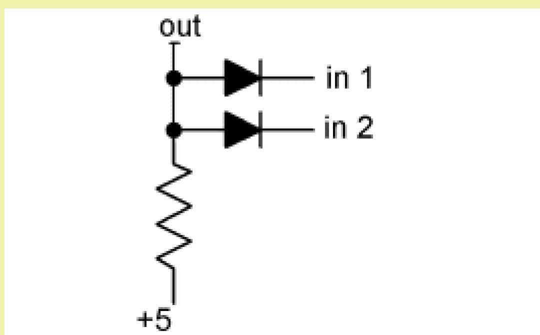
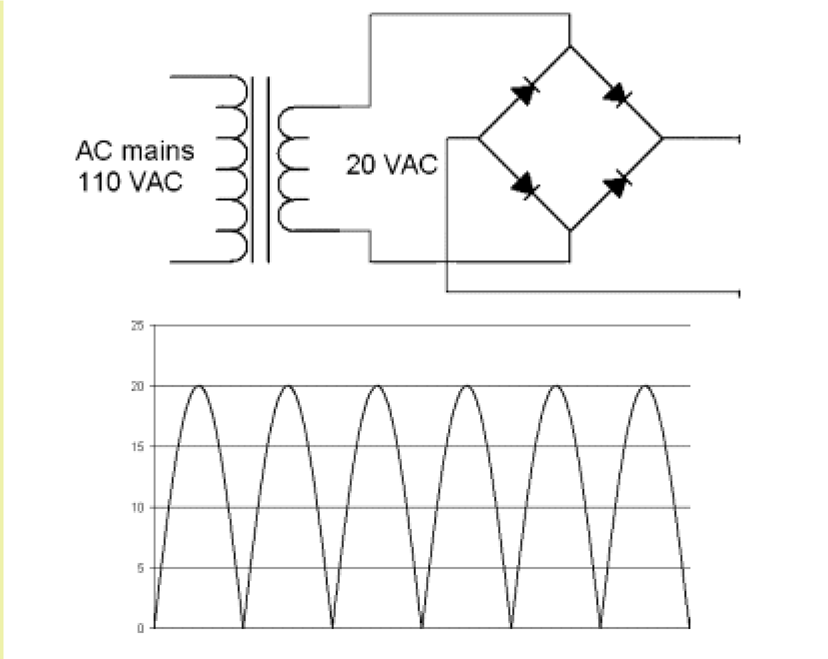
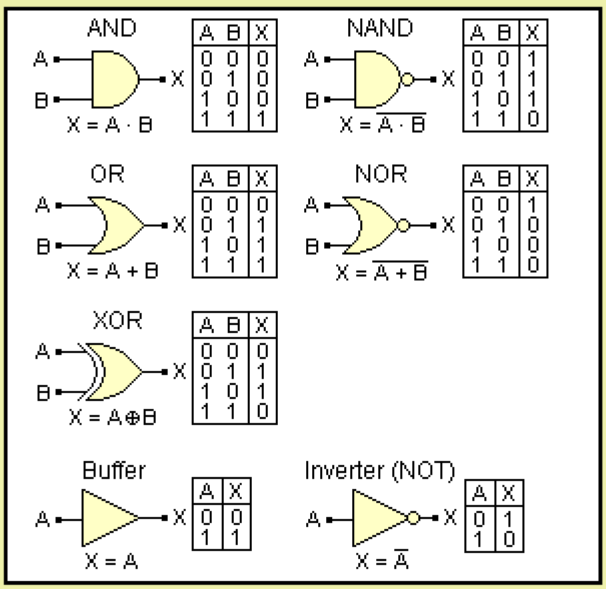


Figure 1-21: A diode OR circuit.



The graph is incorrect. The Y-axis is supposed to be DC volts and the peak of 20v AC will be about 30v.

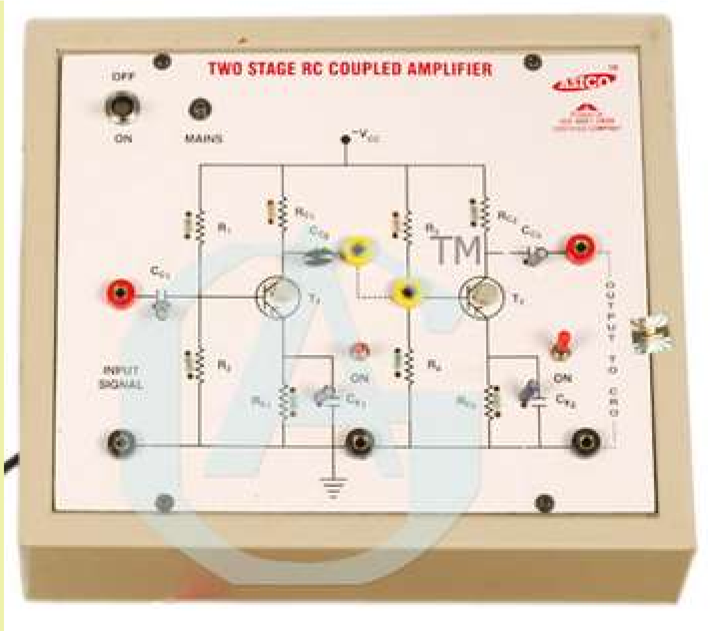
This is one of the best set of TRUTH TABLES:. It is simple, clear and has the Boolean expression for each gate. NO mistakes on this example:



A	B	X (AND)	X (NAND)	X (OR)	X (NOR)	X (XOR)
0	0	0	1	0	1	0
0	1	0	1	1	0	1
1	0	0	1	1	0	1
1	1	1	0	1	0	0

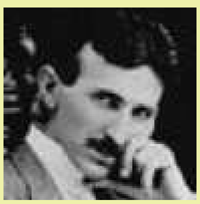
A	X (Buffer)	X (Inverter)
0	0	1
1	1	0

UP SIDE DOWN !!



Here we have an Indian demonstration module using PNP transistors and the power rail is NEGATIVE !!
How can you expect beginners to learn electronics when they are being taught with circuits that are not in the real world !!!

DerStrom8



Sometimes you come upon idiots like **DerStrom8** who makes outrageous claims on Electronics Forums without the slightest clue about anything.

Never trust anything you find on Talking Electronics. They're all either stolen designs or very poorly thought out ones that in some cases can be downright dangerous. Personally, I'd recommend looking for a different circuit from another site, one that Colin DIDN'T make.

What a surprise !!!!
He has never come to me and pointed out all the "STOLEN DESIGNS" the "DANGEROUS DESIGNS" or the "POOR DESIGNS."

Another reader said: **I built his fluorescent inverter for my van a while back and it worked.**

His answer: I'm not saying his circuits don't work, I'm saying they're very poorly designed and in most cases won't last very long (if at all).

It would be wonderful if he came to me and pointed out "all the poor designs"
I have been selling kits for more than 30 years and some readers still have the TEC-1 computer, we designed over 20 years ago. I have sold over 100,000 kits and NO-ONE has said any kit has failed.

You are just making a FOOL OF YOURSELF, stating things that no-one else backs-up and without any examples.
I would have said he was totally-uneducated but he keeps harping on his University Education. I would have thought a University Education would have taught him to back-up every claim with factional material.
Obviously the education has taught him NOTHING.

I would like to know where my "stolen designs" come from?? Someone must be as clever as ME !!
As a point to note: I produced an electronics magazine for 20 years and just after the release of the first issues, one of the other magazines sent representatives to all the advertisers with an offer of half-price advertising for 12 months. When my advertising manager called on the advertisers, they had already spent their advertising budget for the year.
Undaunted, I produced the magazine WITHOUT any advertising.
This annoyed the other magazine so much they produced a HOBBY ELECTRONICS MAGAZINE for 95 cents whereas mine was $1.20.
They flooded every newsagent with their magazine in an attempt to kill mine.

I persisted and eventually they rang me to say: You have won the day." They pulled out with a loss of over $45,000.
But the worst part is this: They read every issue of my magazine and told one advertiser that if they found one paragraph that had been copied from any of their publications, they would sue TALKING ELECTRONICS. Obviously they never did.
I produced hundreds of circuits and have hundreds that never reached publication.
None of my circuits were even vaguely similar to anything designed by anyone else and I have never been served with a copyright infringement.
I have sold over 750,000 books and never received a letter or comment on a faulty design or poor engineering.
For someone to say "STOLEN," "DANGEROUS" or "POOR DESIGN," without any references, just goes to show that an education is worthless.
You don't even get this sort of stupid behaviour from STREET URCHINS.
The problem is the ELECTRONICS FORUM WEBSITE closes down the discussion before anyone can respond. This has happened on many occasions where the whole discussion has been drivel and when you respond with comments that expose their ignorance, they "moderate" your reply and TURN YOU OFF.

But the good news is, other people are stealing my circuits and putting them on their site, without any reference to Talking Electronics. However everyone knows the layout of my circuits and it gets referenced back to me.
I have never said all the 555 circuits were invented by me. All the simple circuits are generic and have been known for years. I have sorted them out and put in all in a single file for easy reference. That's why I get 7,000 visitors each day, of which about 200 - 300 read the "555 section." Hobbyists keep coming back because everything is neatly arranged and easy to find.
No-one else has provided the extensive content or backed it up with descriptions of how the circuits work.
I only take comments, like those above, seriously if concrete evidence is provided. Otherwise it's just "sour grapes."
It only upsets me to think a person with a "University Degree" would make such a FOOL of himself. It's a bit like doctors (like Dr Shipman who killed 50 old women) damaging the profession by making idiotic statements.

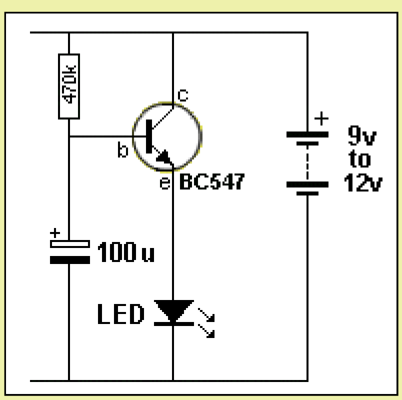
Here is a typical result from readers of the electronics forums. The request is for a very simple circuit:

I want a 555 timer circuit diagram , which will result in turning an LED ON AFTER a time delay, but staying on permanently.

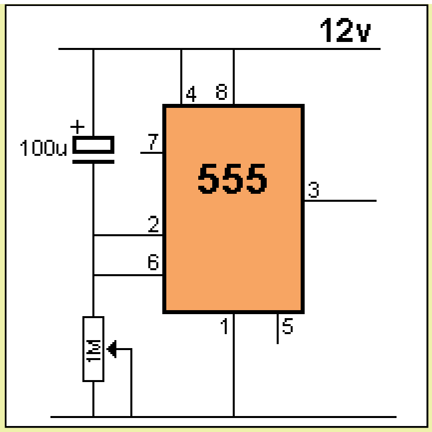
In other words, I want a circuit that will do the following:

I push the trigger, then there is a time delay where the LED is off, then after the delay, the LED is turned on, and remains on. It is aimed as a one time use, its use in my project is only required to turn on automatically once, then I can reset manually for the next time.

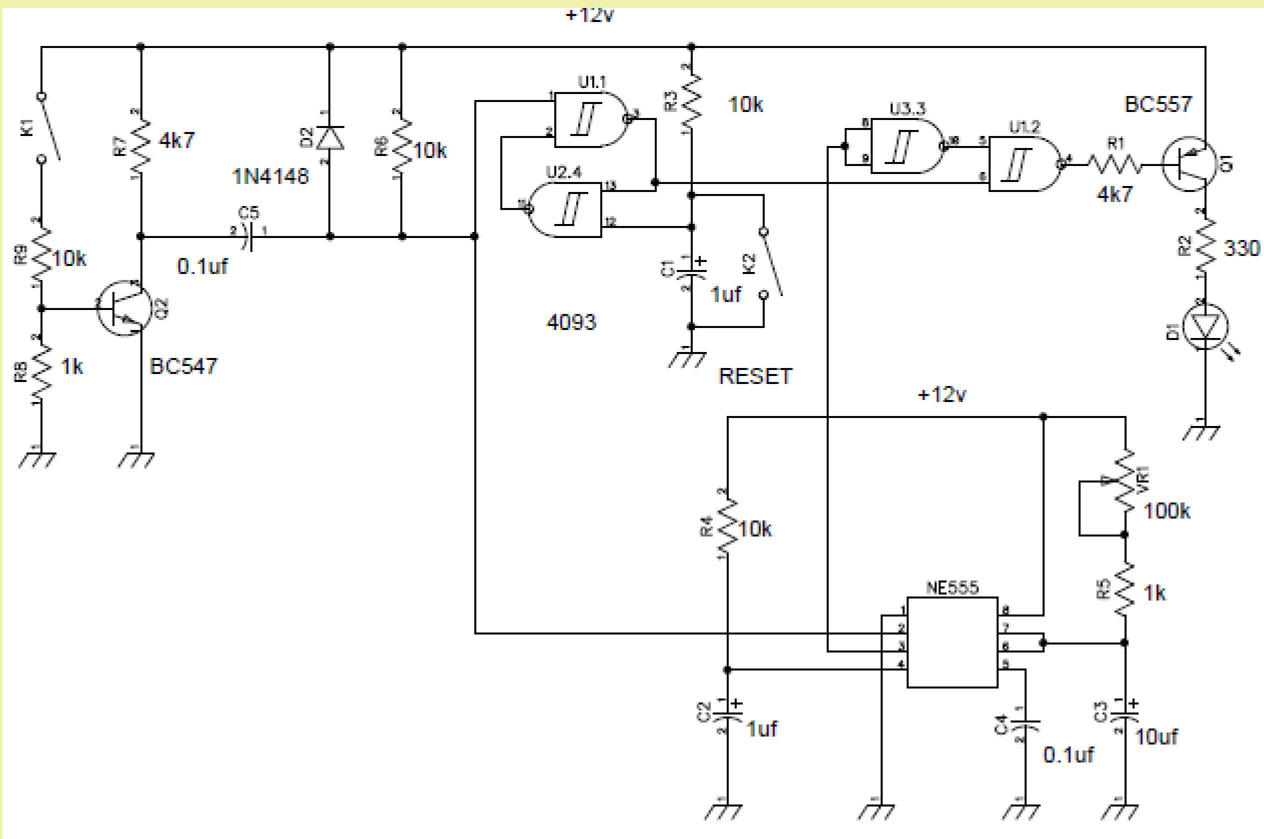
A 555 takes 10mA when sitting around doing nothing and is very wasteful. My suggestion is as follows:

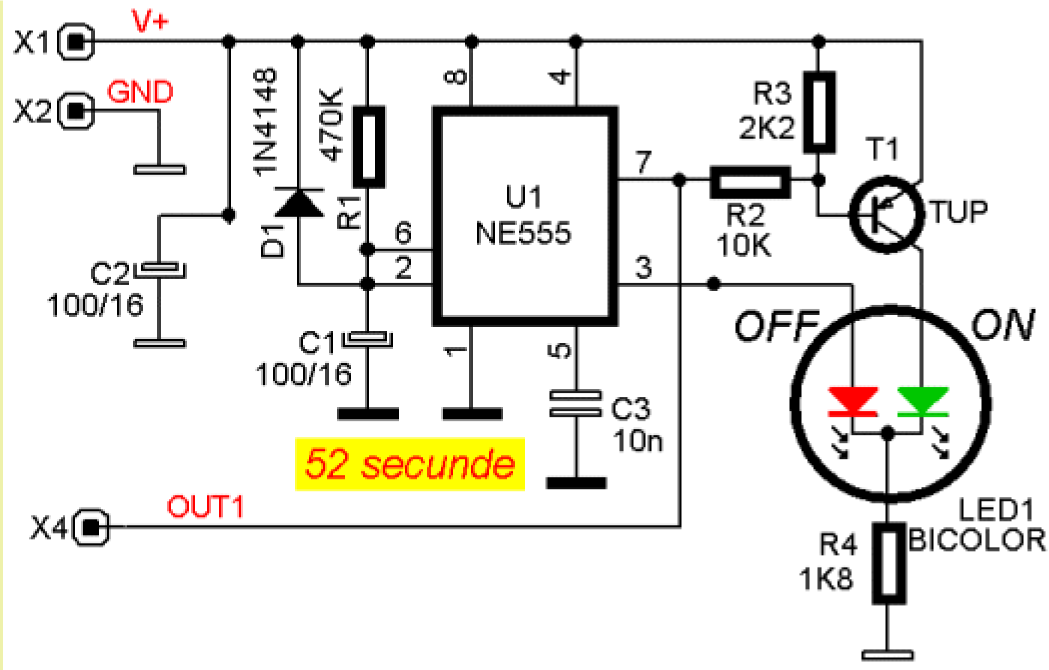


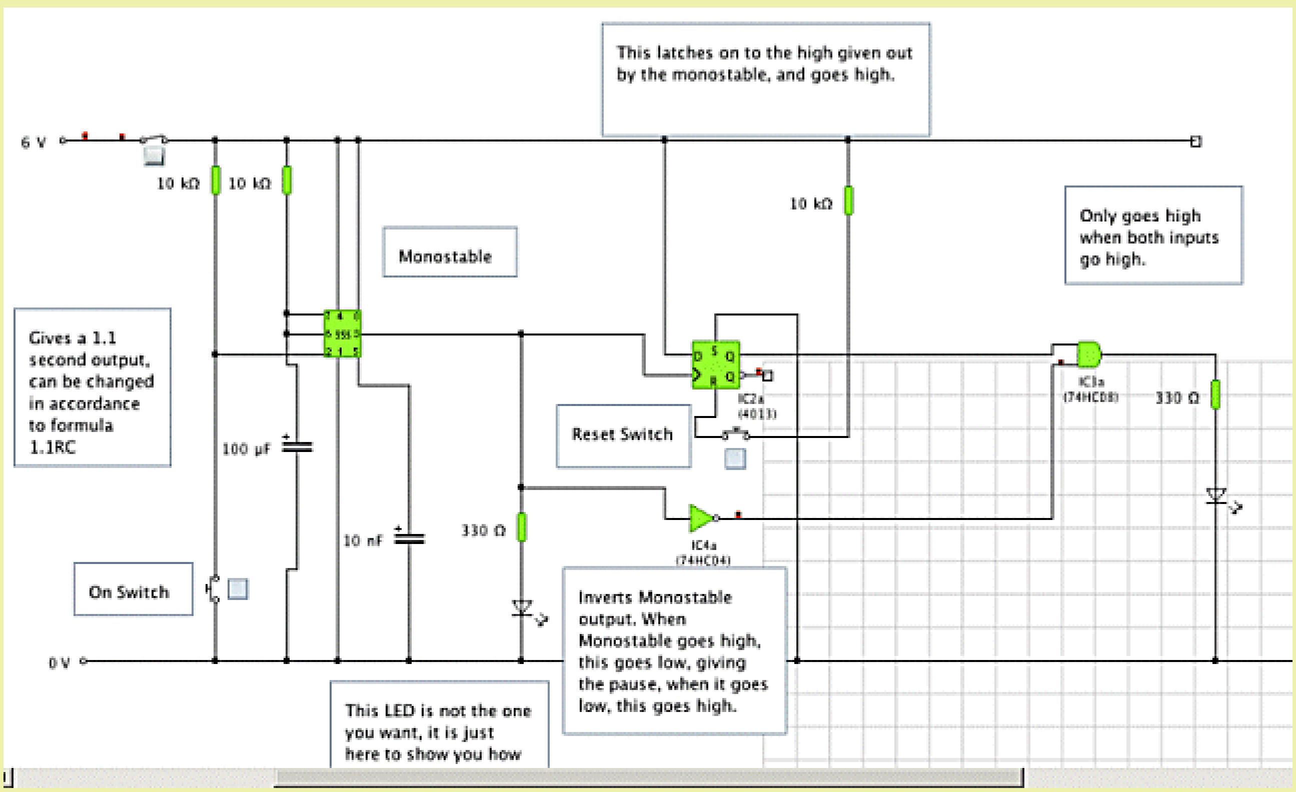
However if the original poster wants a 555 circuit, here is the answer:

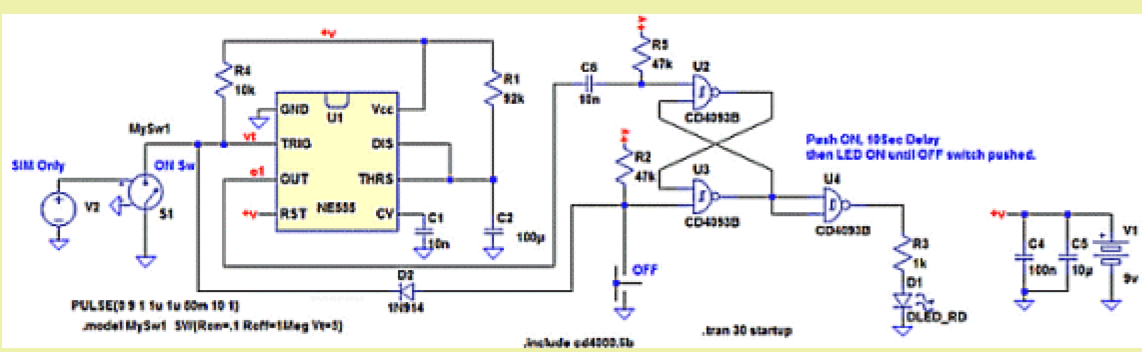


Here are some of the answers from other readers:









As you can see, some of the circuits are very complex and you would think they represent GOOD ENGINEERING.
But the skill in designing a circuit is NOT to create a COMPLEX design, but the simplest design possible.

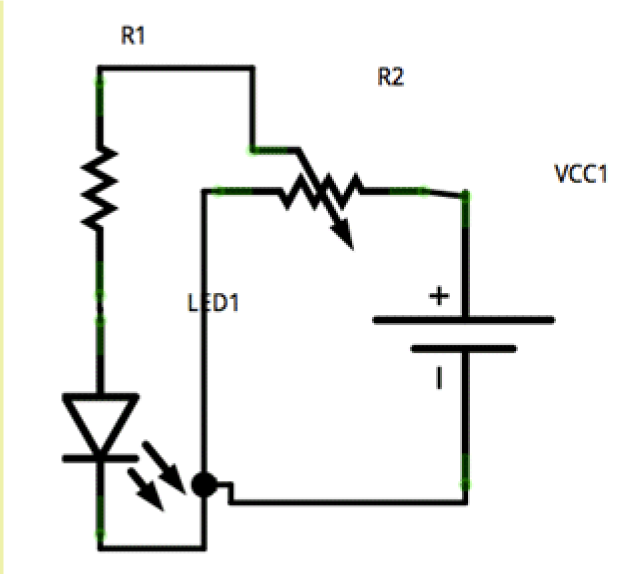
Anyone can add more and more stages to get a final result, but the skill is to look at the original requirement and work out the simplest circuit possible.

The first transistor circuit (above) uses the gain of the transistor and the very small current through the 470k base resistor to deliver about 10mA to the LED without a current-limiting resistor in the emitter.
If you go back to the first few pages of this eBook, you will see mass produced circuits with extra components and faulty designs that depleted the battery in 2-4 weeks.
Every time you design a circuit, you need to take into account the simplicity of the circuit as someone else will see the design and remove a few components and put it on the market at a lower price.
The happened with the Goddard turntable. It had over 120 components with cranks and levers and push rods and friction-bearings, just to put the arm on the record.
Someone came in with a cam-version with 10 components and overtook the market.

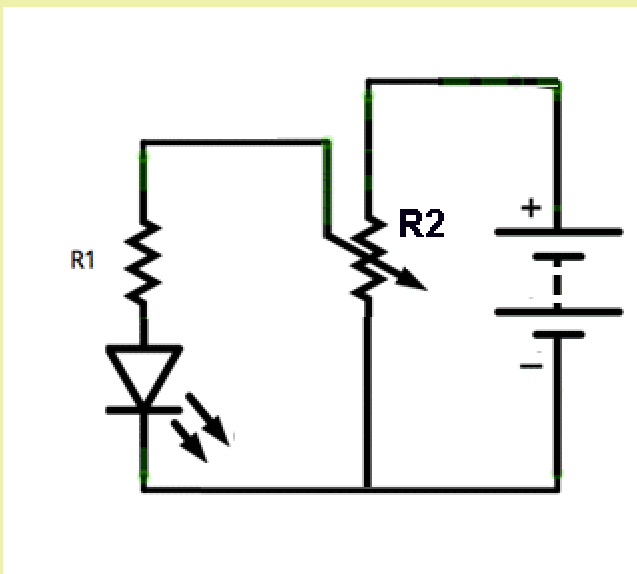
I want to mention something that aired on cable vision today.

My father worked for the Sunshine Harvester Company 60 years ago and the owner had designed a horse-drawn harvester for wheat that stripped the seeds from the stalks. This resulted in some of the seeds being dropped to the ground and any stalks that were blown over by the wind before harvesting, were not able to be harvested.
A young farmer who left school at 14 saw the problem and bought books on engineering (while living in a country town).
He thought of the idea to cut the stalks and separate the seeds ON THE HARVESTER and throw the chaff out the back.
He had no education, no tools and no money.
He built a prototype in his shed out of junk lying around and this 3rd prototype worked very well. He had a contest with his brother and his equipment worked better and faster.
His patents were bought by the Sunshine Harvester Company and his design was the best in the world.
Eventually every-one else in the world copied his idea and it's very hard to realise that he was the inventor of the Self-propelled Combine Harvester.
I am bringing up this point as the new round-bale harvester is so simple compared to the original rectangular bale that it would amaze you.
Someone saw the complexity in cutting and ramming fodder into a rectangular shape that he thought of creating a round bale that was not only cheaper to produce, but 6-10 times larger and could be rolled across the paddock.
This is what I call BRILLIANCE.
These few men have saved the farmers billions of dollars. Absolutely billions.
Not only do the harvesters pick up wind-blown crops, but they are bigger, faster, GPS controlled and gather more of the crop than ever before.
You can actually say they turned farming from a disaster to a success.
Farmers only work on a 5% profit-margin and nearly all of them would say the profit-margin is more like 1%.
Nearly all farmers in Australia are bankrupt and if it were not for the 15% improvement produced by cutting the "ears" instead of stripping the seeds, wheat farming would have never flourished. It's as simple as that.
I can remember my father saying the company was changing from wire-tying square bales to rope tying.
One of the engineers had the job is designing the tying mechanism.
He left work on Friday and worked on the design during the weekend and returned on Monday with the answer.
That's what I call CLEVER. I know inventors are clever, but to be given a challenge like this is quite considerable.
This operation had never been done before and tying with wire is completely different to tying with rope (string).
Even though this website concentrates solely on electronics designs, you have to have an appreciation for mechanical engineering if you call yourself a true engineer.

If a student was told his teacher is USELESS, he could look on the web and teach himself the correct way to learn electronics.
Look at this RUBBISH from a teacher using a PowerPoint Presentation:

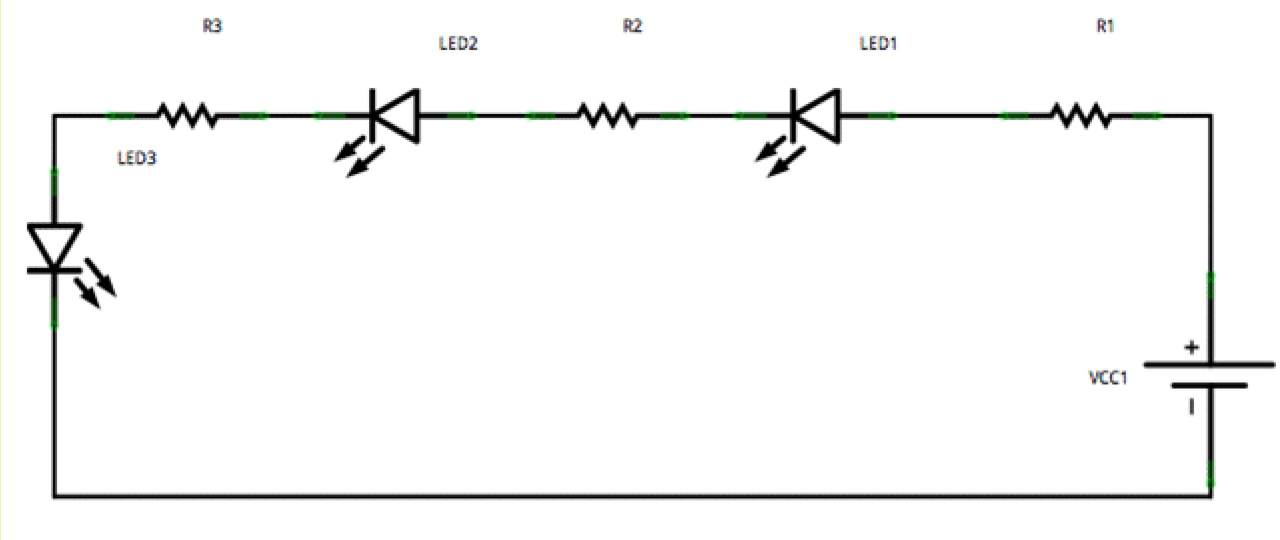


It is supposed to be a VOLTAGE DIVIDER. This is how the circuit is supposed to be drawn:



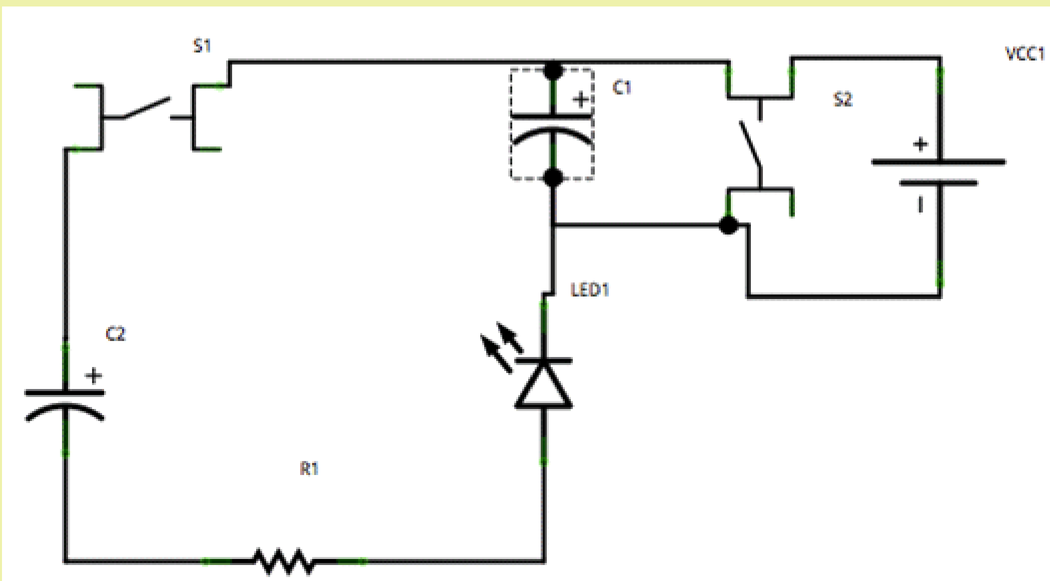
The pot is now clearly across the rails and provides a percentage of the rail-voltage to the LED. The battery is drawn as a number of cells and there are no "squiggles" in the wiring of the circuit. I can clearly see what is happening with this circuit. This is the way a circuit should be drawn. It should be clear and simple and create an immediate "picture." The other circuit was drawn by a teacher who knows NOTHING about electronics and is just WASTING THE STUDENTS TIME.

Another poor circuit:



You only need 1 resistor. This circuit is giving the wrong example to a student.

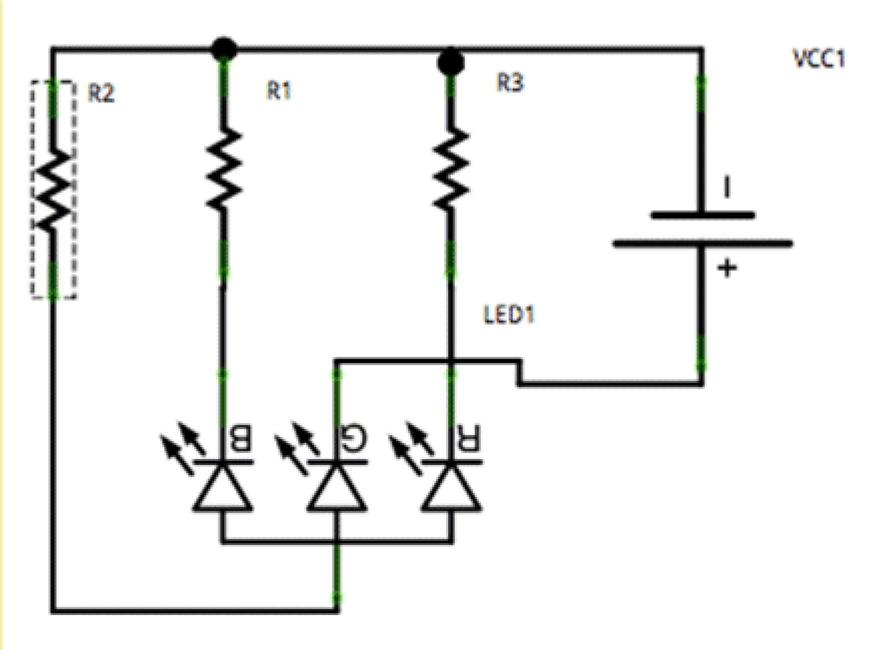
Look at this:



Switch 2 is shorting across the battery !!!!

How much more stupid does a teacher have to get ???

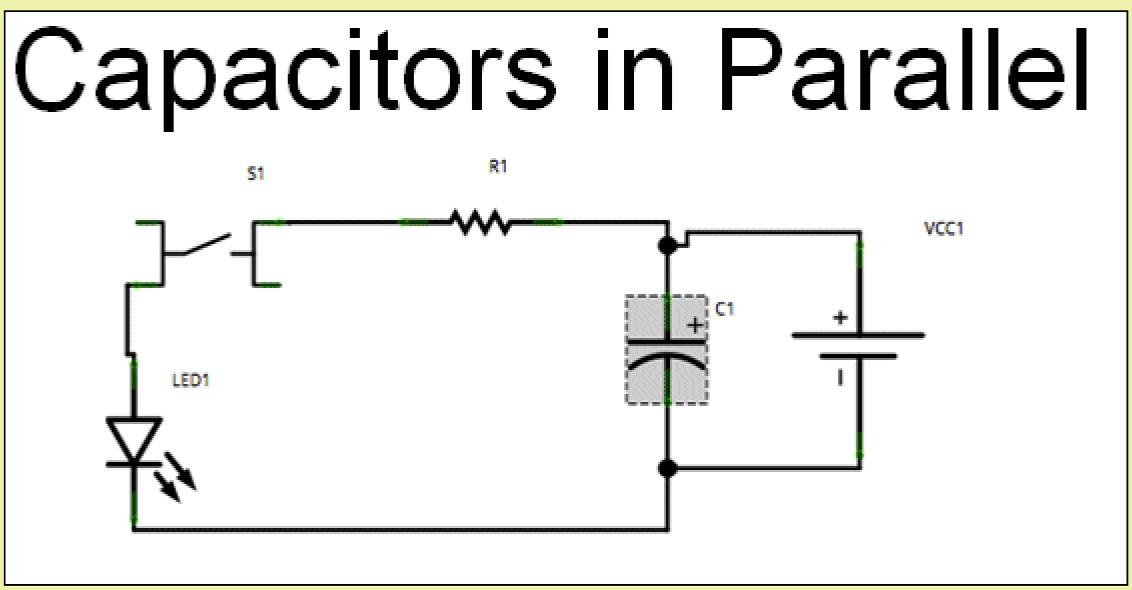
I have no idea what this circuit is supposed to do:



Capacitor is two separated charges.
Known charge up time.
Know discharge time.
Two major kinds
- Electrolytic, asymmetric, bipolar
- Ceramic, symmetric

The teacher is supposed to be talking to BEGINNERS. He introduces ASYMMETRIC properties of a capacitor, when he can't even spell "Known." And there are MANY different types of capacitor, not just two.

He talks about **Capacitors in Parallel**:



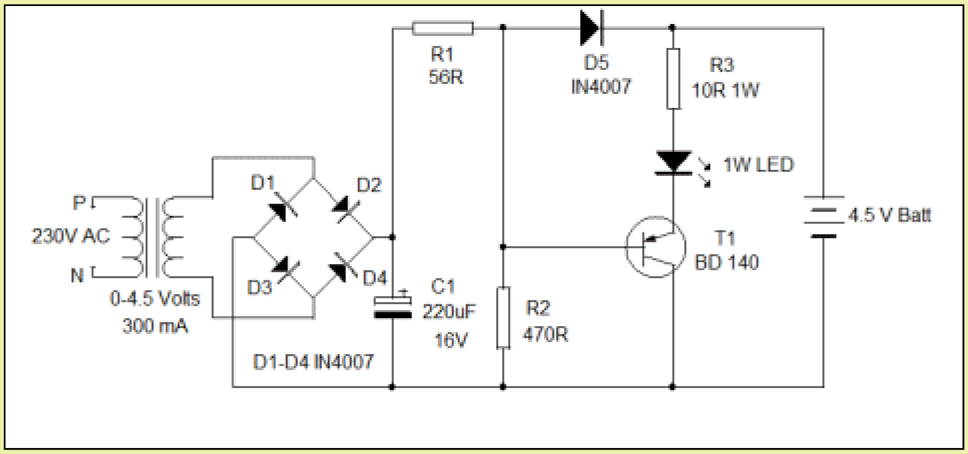
He really means **CAPACITORS ACROSS THE SUPPLY**. **Capacitors In Parallel** refers to two capacitor in Parallel.

What a disaster !!!

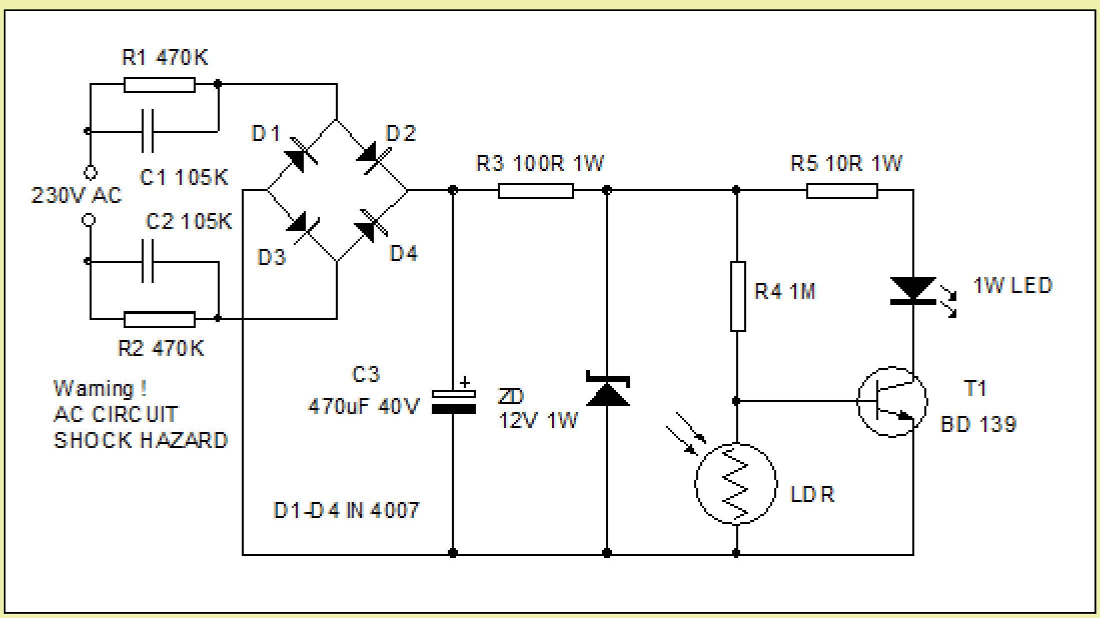
This is an example of **A LITTLE KNOWLEDGE IS A DANGEROUS THING**.

Here's some more untried circuits from **Professor D Mohan Kumar**:

In the following circuit, the transistor is an emitter-follower and the voltage between base and emitter will be 0.6v. This means the emitter will always be 0.6v above the 0v rail. The LED drops 3.6v, making a total of 4.2v. The voltage across the 10R resistor will be 0.3v and this will allow a maximum current of 30mA. The 1 watt LED will not be very bright!!



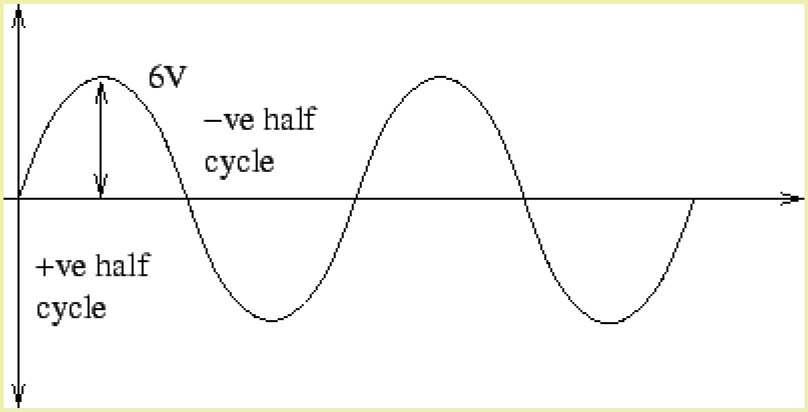
The 1 watt LED will get 30mA MAX !!



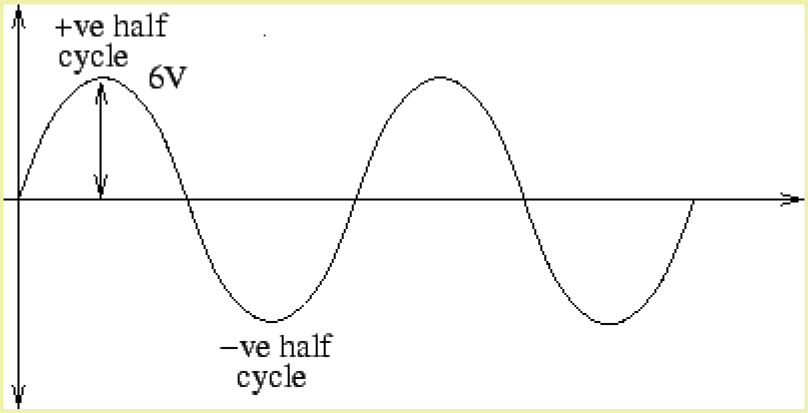
The LED will get 1.5mA !!!

The 105 capacitors on the front end are in SERIES, making a total of 470n. This will produce a current into the circuit of 35mA. The LED will not be very bright.
But there's another MAJOR FAULT.
Here's the simplest way to look at how a transistor works.
The transistor divides the value of the base resistor by 100 to 200 and effectively puts the result between the collector-emitter terminals. In the circuit above the base resistor is 1,000,000 ohms. Divide this by 200 = 5,000 ohms. The LED will get 1.5mA !!!
What a disastrous circuit !!

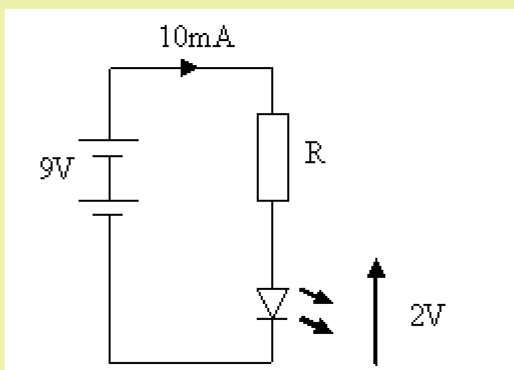
Look at this misleading diagram in a set of Lecture Notes:



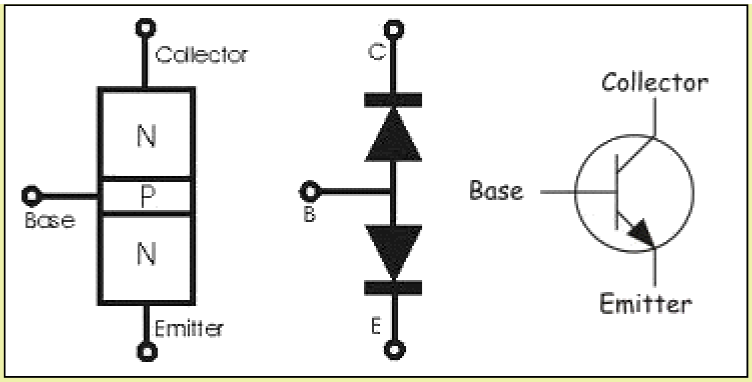
It should be:



What is 2v with an ARROW ??? We don't use an arrow for voltage as we don't say VOLTAGE has a direction of FLOW. The arrow representing 2v opposes the 10mA current and causes CONFUSION.

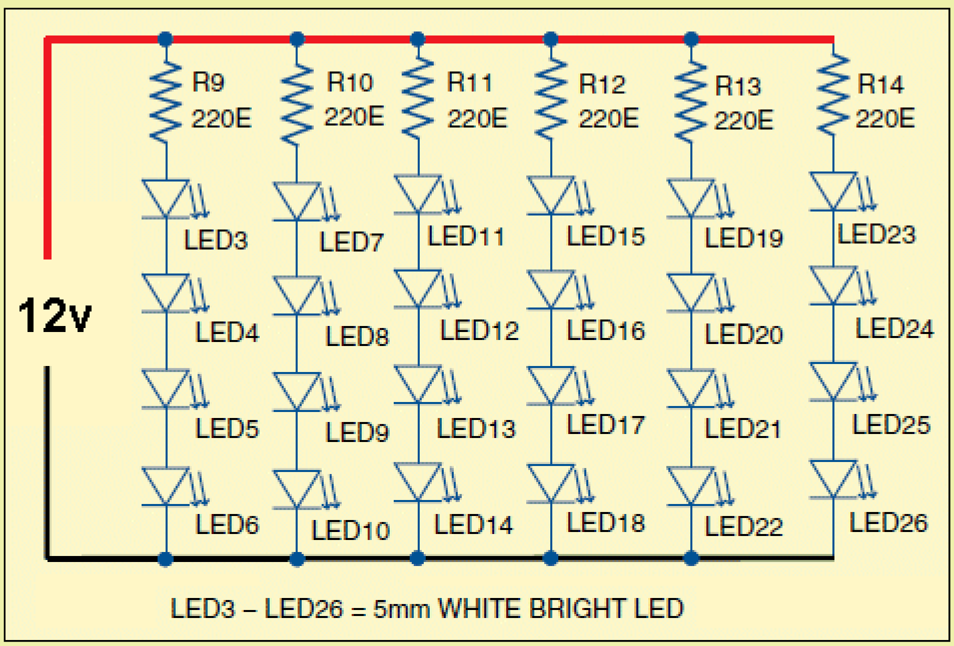


THE TRANSISTOR AS TWO DIODES



It is quite STUPID to describe a transistor as TWO DIODES. Firstly, you cannot connect two diodes to produce a transistor and it is clear the top diode will never conduct because it is around the wrong way.
Too many discussions go into the physics of how a transistor works with electrons, holes, depletion-region and more.
All this makes learning very confusing.
It is much better to make a simple statement to say that **current into the base will allow current to flow via the collector-emitter junction**. The base needs a **voltage of 0.6v** before the transistor turns ON and current into the base will be increased by a factor of about 100, through the collector-emitter.

Here's another poor design from **Electronics For You** March 2014.
No other magazine makes the same mistake over and over and over again. They have absolutely no idea how to drive a string of LEDs. I have told them more than 10 times and they still create stupid circuits like this:



White LEDs drop 3.2v to 3.6 when they are working. If you construct the circuit above, the LEDs have only 2.9v across them and the current is 5mA. The battery delivered 12.8v for this test. With a 12v battery the current was 3mA.
What a useless circuit !!!!

Here's another poorly designed circuit: **LOCKER ALARM**

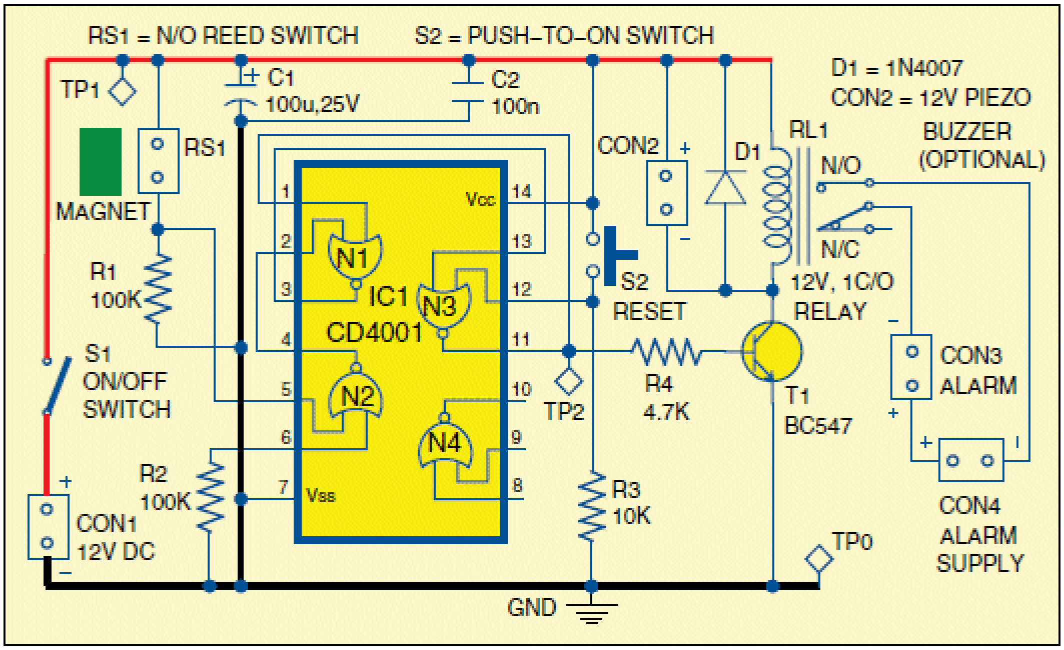
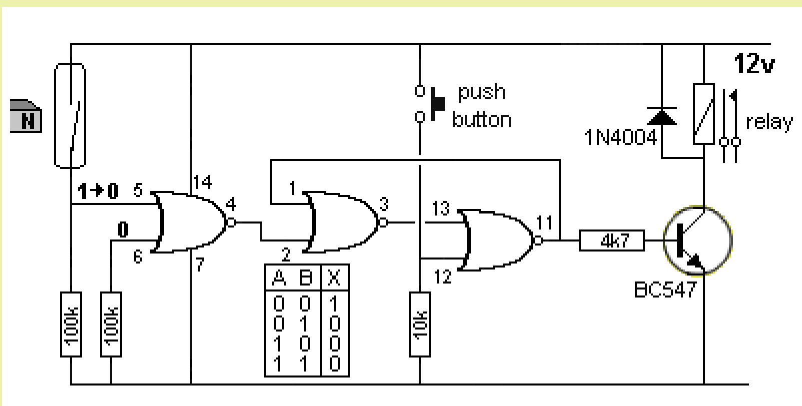
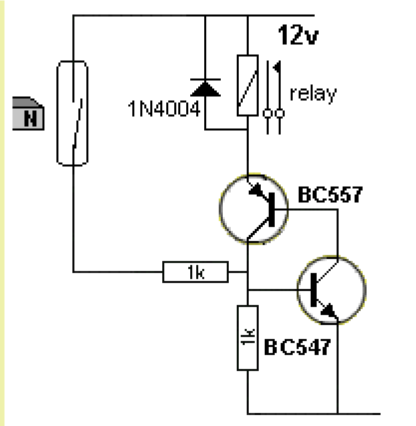


Fig. 1: Circuit diagram of the locker-security alarm

A circuit diagram does not keep all the gates within the chip. That's a wring diagram.
I have absolutely no idea what the circuit does.
It needs to be re-drawn as a CIRCUIT.



The 100k on pin 6 is not needed. The reed switch must be closed (to produce a HIGH = 1) and when it opens (=0) the alarm will activate.
The same can be achieved with a BC557 and BC547 configured as a LATCH.
The reed switch is kept open by keeping the magnet away from the switch. When the locker door is opened, the magnet touches the reed switch and activates the alarm. Opening the reed switch does not stop the alarm. The power must be turned off to reset the alarm.



A LATCH CIRCUIT

CABLE TESTER

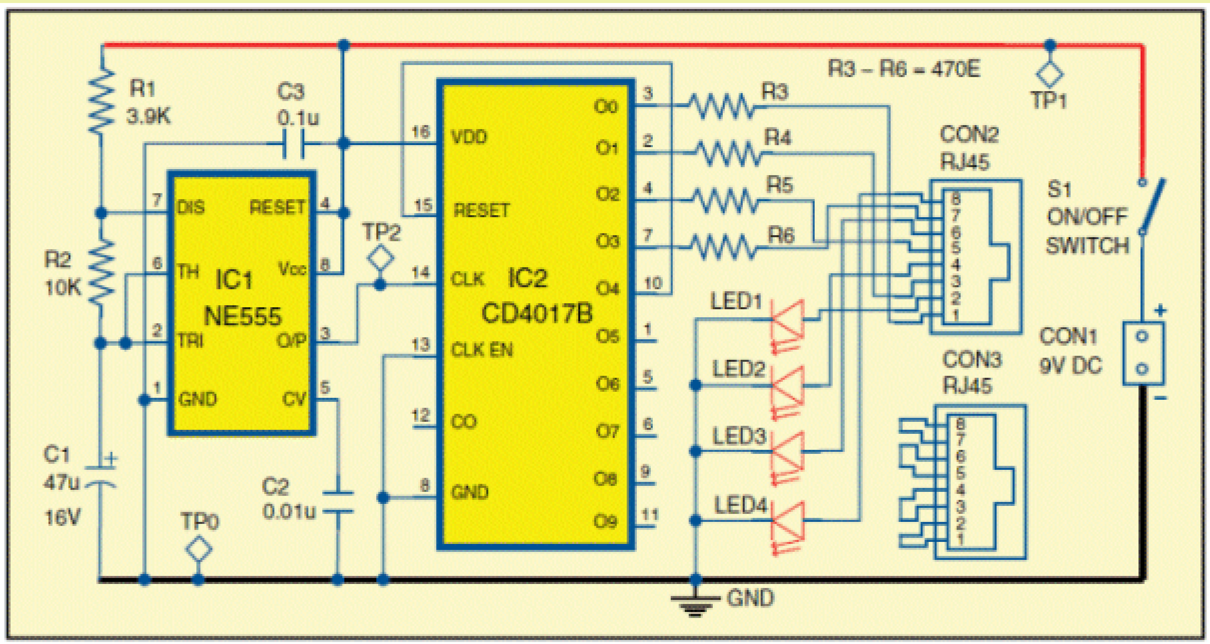
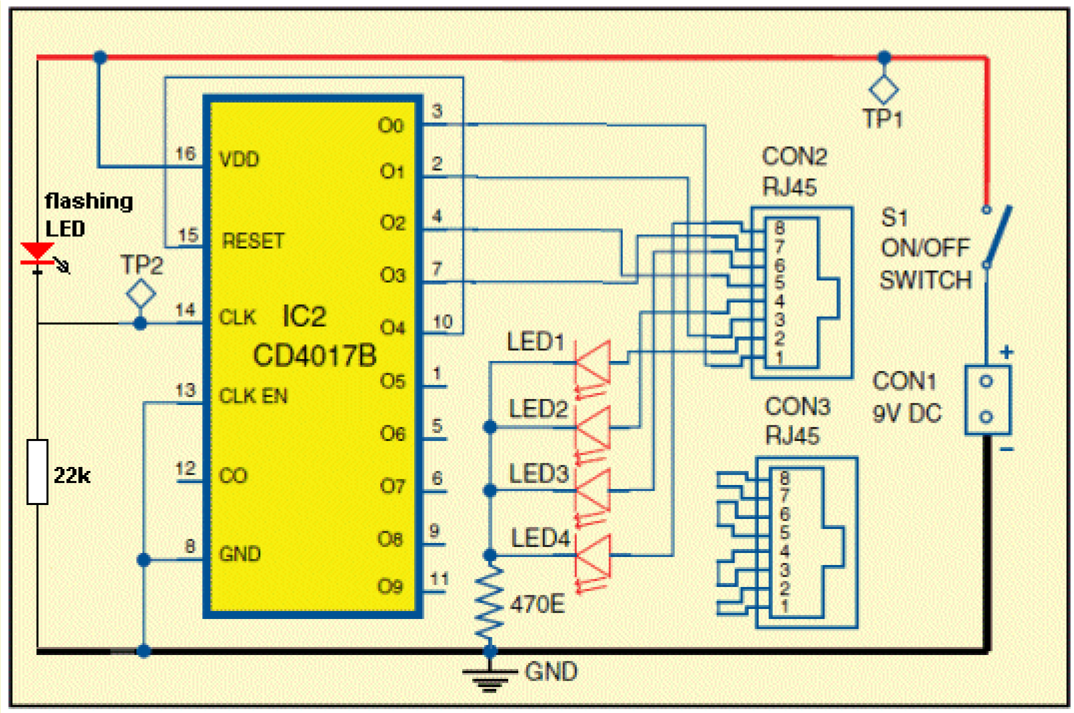
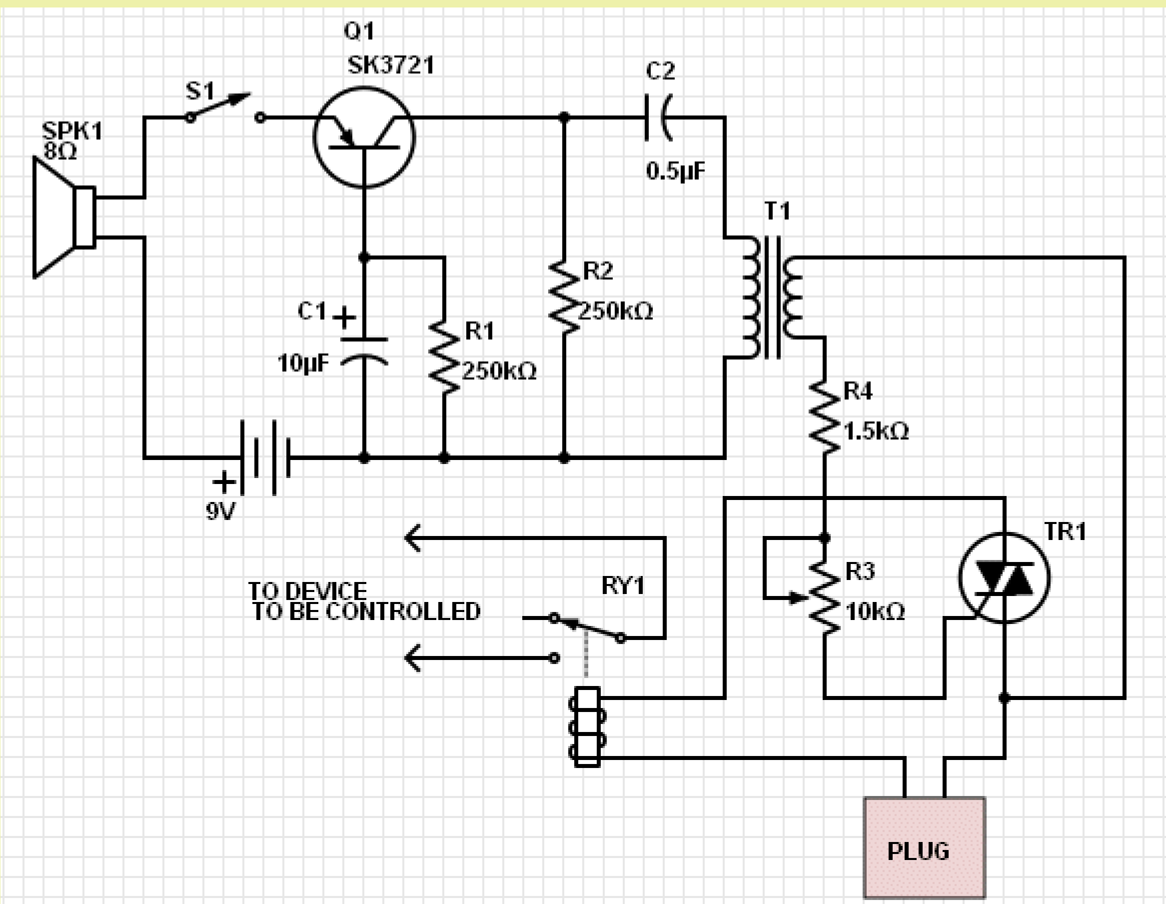


Fig. 2: Circuit diagram of RJ45 cable tester

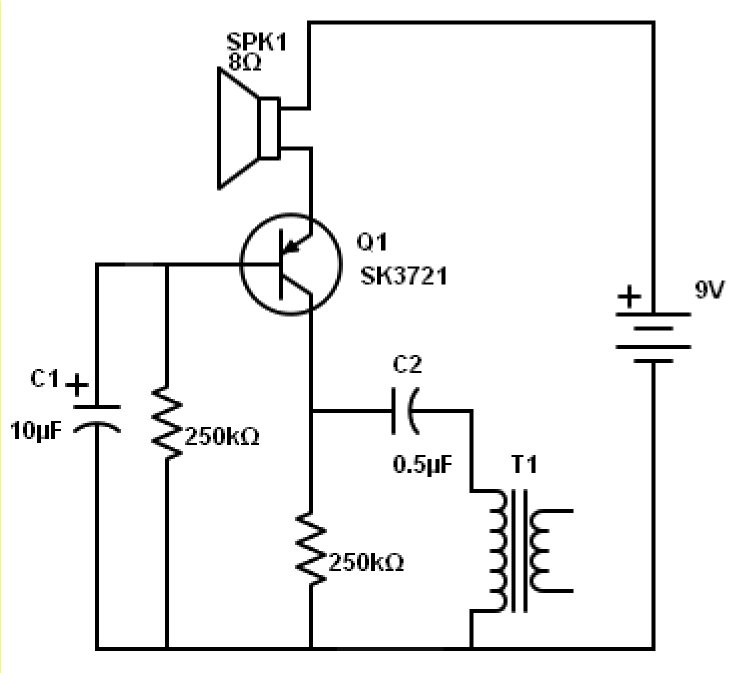
Only 1 470R resistor is needed as only 1 LED is illuminated at a time.
The 555 can be replaced with a flashing LED to make the circuit very simple.



Here we have a circuit drawn on the website: [Schematics.com]
Anyone can draw and post a circuit that may or may-not work.
This circuit DOES NOT WORK.



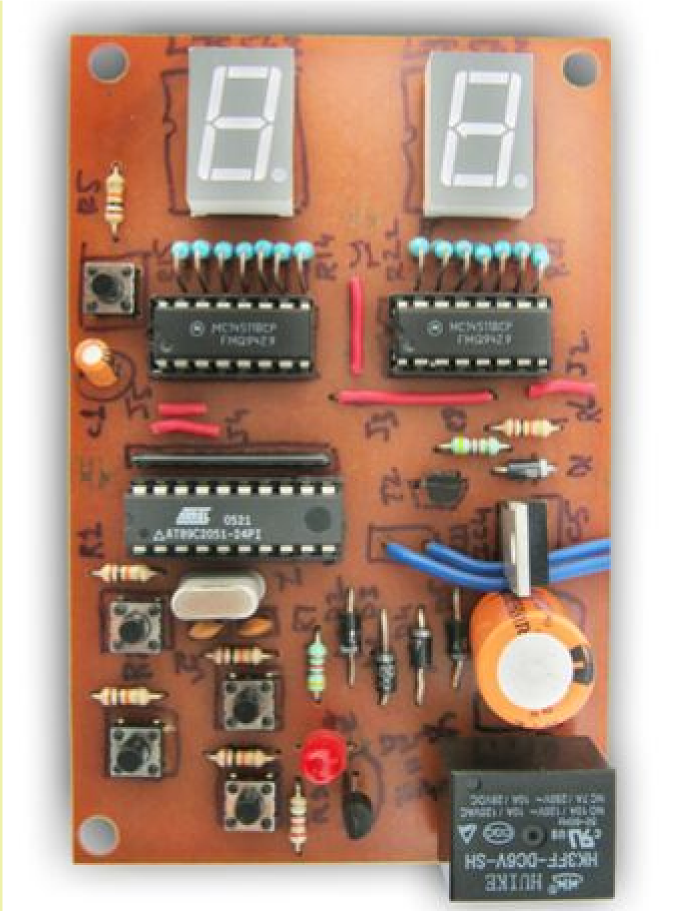
Firstly you have to re-draw the circuit:



The circuit re-drawn so you can work out what is happening

The transistor is a common-base configuration, but the problem is the 250k on the collector. This value is TOO HIGH. The transistor is tuned on via the 250k on the base and suppose the transistor has a gain of 250, it will divide the 250k by 250 to become a 1k resistor.
A 1k resistor in series with 250k puts very little voltage across the transistor and the collector will be about 9v. The 0.5u capacitor will be fully charged.
When the transistor turns OFF, the capacitor is discharged via the 250k and it will not be discharged vey much.
When the transistor turns ON, the capacitor can only be charged with the very small amount of energy that was removed by the 250k. This means the transistor is only acting like a 250k resistor and very little energy will be passed to T1.
That's how you work out what is happening in this type of circuit.

Electronics For You magazine keeps sending invitations to subscribe each month and they offer a free gift to the value of the subscription. This means they make zero profit on a subscription.
Obviously sales are dwindling and their claim of 45.000 subscribers is grossly exaggerated.
On top of this they have a kit section with somewhat useless kits.
The following kit is a 00-99 counter. Look at the PC board!!!
This is the worst example of a Printed Circuit Board you will find anywhere in the world. For a magazine to display such rubbish is an indication of their intelligence.
The kits costs $15.00 plus $40 for postage !!!! It's no wonder they have NO BUSINESS.



WHAT A DISGRACE !!!

Another Junk circuit from ELECTRONICS FOR YOU April 2014:

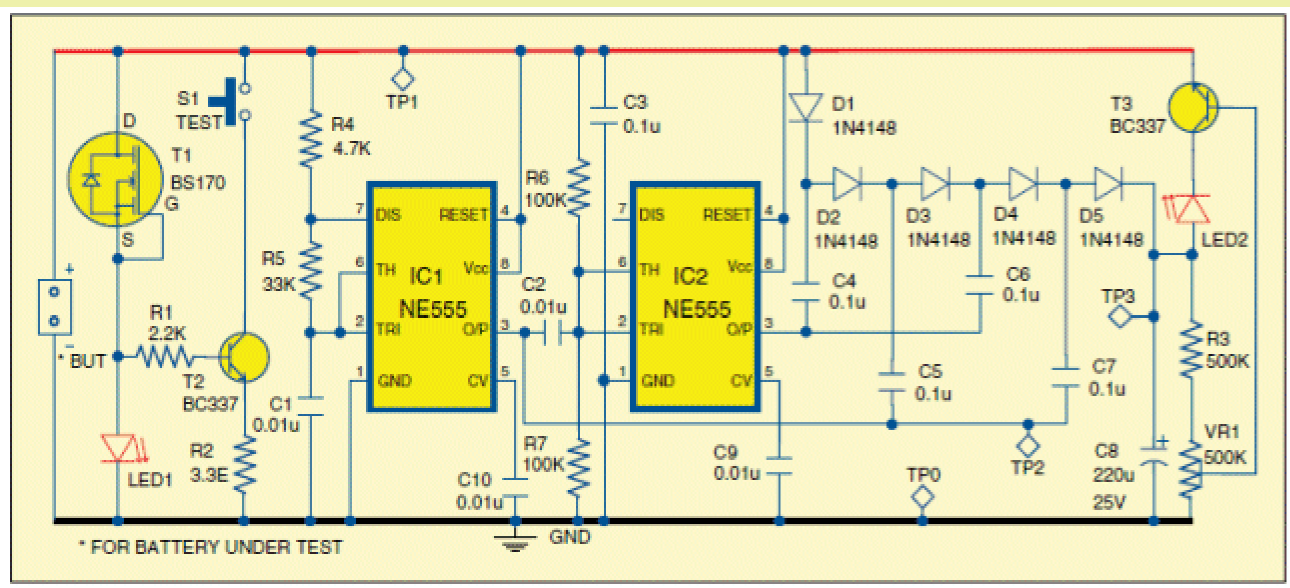


Fig. 1: Circuit diagram of the battery tester

The circuit tests batteries from 3v to 15v.

Mistakes:

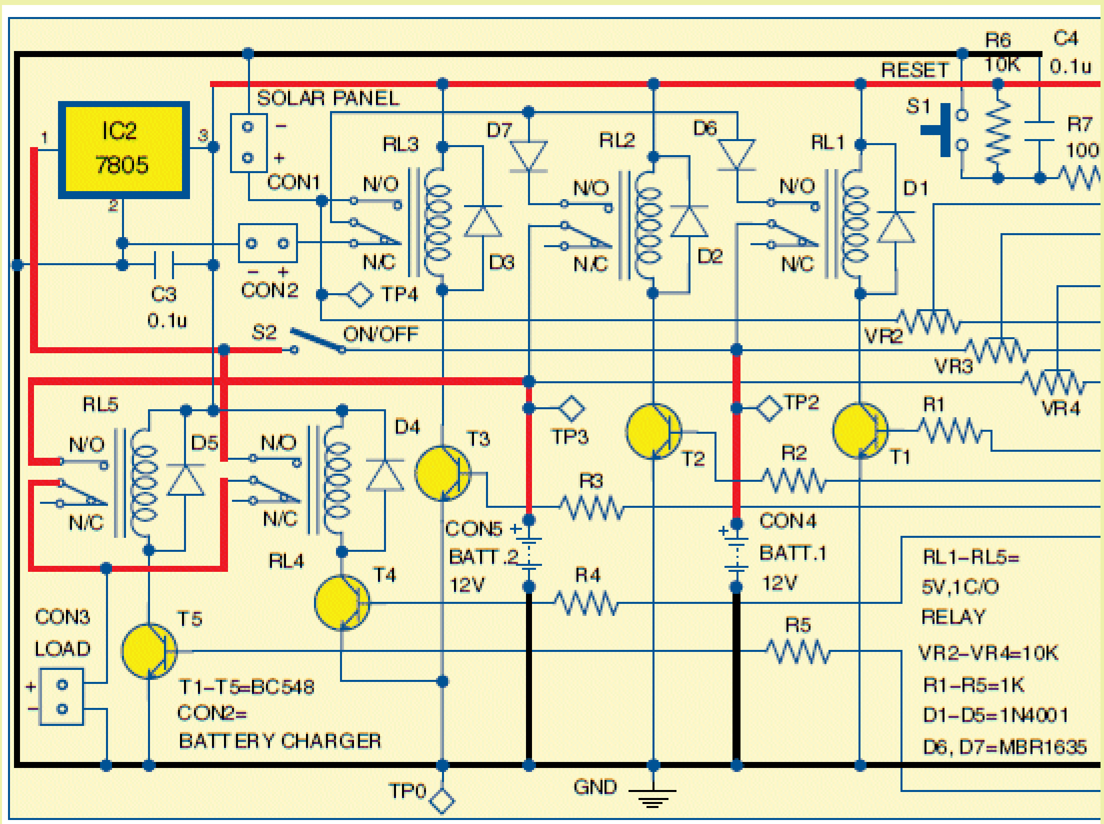
1. The BS170 provides constant current for LED1.   RUBBISH !   Build the circuit. The circuit does not work !!! How does a FET with the gate tied to the source, deliver a constant current ?? What is the constant current ?? How can you increase the constant current ?? THINK . . .   nothing makes any sense. Maybe he is trying to say the LED and BC337 will provide a constant current LOAD, but the circuit has no current-limiting resistor for the LED.

2. The NE555 does not work below 5v. The circuit WILL NOT WORK on 3v.
What is the reason for multiplying the voltage? The circuit is far too complex.

HOW TO TEST CELLS and BATTERIES:

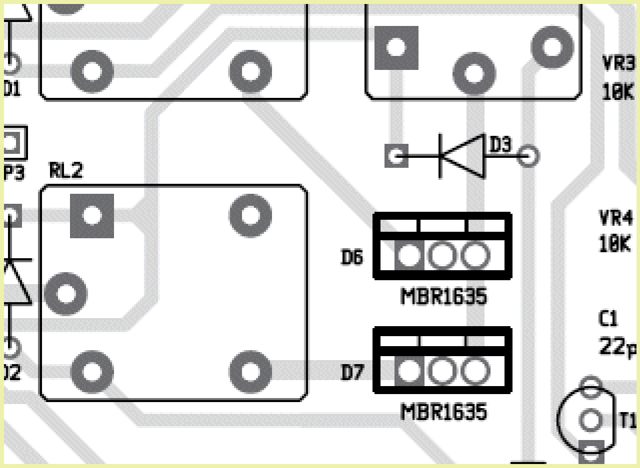
For AA and AAA cells, use an analogue multimeter set to 500mA range. Test a single cell and if the needle swings full scale very quickly, the cell is ok.
For alkaline AA and AAA cells, you can use a digital meter set to 10A range. A good cell will read 2.8A
For a 12v jell cell, use a 12v car globe (18 watt or greater). The globe will illuminate very bright if the battery is fully charged.
These are GUARANTEED, RELIABLE ways to test a cell or battery. After making lots of tests with lots of batteries, you will know what to expect.

Another untested circuit from ELECTRONICS FOR YOU April 2014:

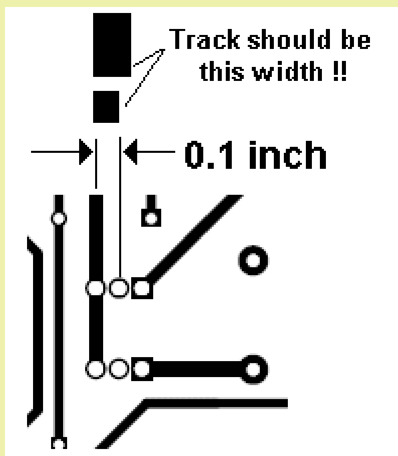


Two 80 watt solar panels are connected in parallel to charge two 80 A-Hr batteries.
This is a HIGH CURRENT design and the tracks on the PC board are as narrow as a hair ! The charging current will be at least 5 amps and maybe 10 amps and the power diodes have no heatsinks. One of them could dissipate up to 8 watts and without a heatsink it will fall off the board. Look at the lands around the leads of the diodes !! The leads get very hot and will need a very large land to prevent the solder melting. A lot of the heat from the junction flows down the leads and they represent a very large percentage of the extraction-process. The engineer who "flopped" this board together has absolutely no idea of POWER ELECTRONICS. The diodes are in the middle of the board. They have no heatsink. They are close together with no allowance for heat dissipation. What a disaster ! Obviously the circuit has never been tested.
I have had a 1-amp diode fall of the board because the pad was too small. I have also had a resistor heat-up enormously because the pad and track was smaller than for an adjoining resistor. The pad and track provides an ENORMOUS effect on dissipating the heat from a component and the 5-amp diodes (5-10amp current-flow) need a very large pad and track to prevent them falling off the board. The leads of a diode get VERY hot when current is flowing, even though the body of the diode may have a heatsink.
As soon as you have a circuit carrying more than 1-amp, you need to learn about POWER ELECTRONICS. The heat generated by a current increases ENORMOUSLY because it is determined by the formula $P=I^2R$.
For instance, the losses may be 1 watt when 1-amp is flowing but they will be **4 watts** when 2-amp flows !!
The losses from a diode increase considerably when the current increases because the voltage-drop across the junction increases. For some diodes this voltage-drop increases from 0.7v to more than 1.1v. For the MBR1635, the increase is only small (from 0.55v to 0.65v). But at 12 amps, the wattage dissipation can be nearly 8 watts.

None of this has been taken into account when designing the board or allowing for heatsinks.
When you are preparing an article for 40,000 readers, it has to be presented by EXPERTS and not contain a myriad of mistakes.
I have had no reply from the technical personnel at **Electronics For you**.

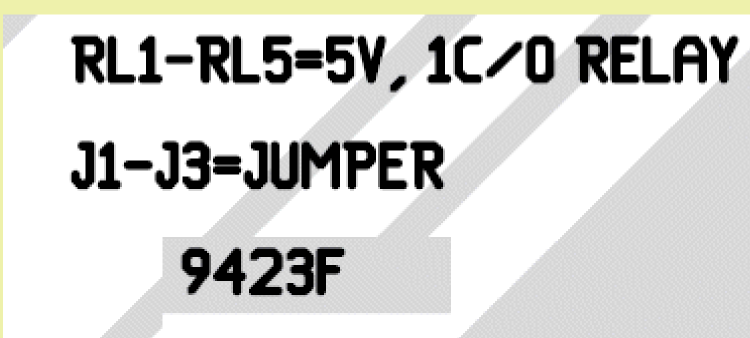


The trackwork around the power diodes will never carry 10 amps !!!!!



The track should be between 100 thou and 200 thou
And the pad should be MUCH larger

As a side issue: **Electronics For You** claim all the projects are tested. if this is the case, they would have a PC board and the project built on the board. Where is the photo??? For the same cost they can get 10 boards made and supply them via Kits N Spares. Where are the boards and where are the kits?
All the projects I design have PC boards and complete kits.
In addition, all my boards have the name of the project and every component is labelled. When you have 300 different kits, you don't label a board: 9423F.



The only ID on the board is 9423F

When I first started producing my electronics magazine 30 years ago, the only other electronics magazine in Australia was ELECTRONICS AUSTRALIA. They labelled their boards CC021985. There was no component

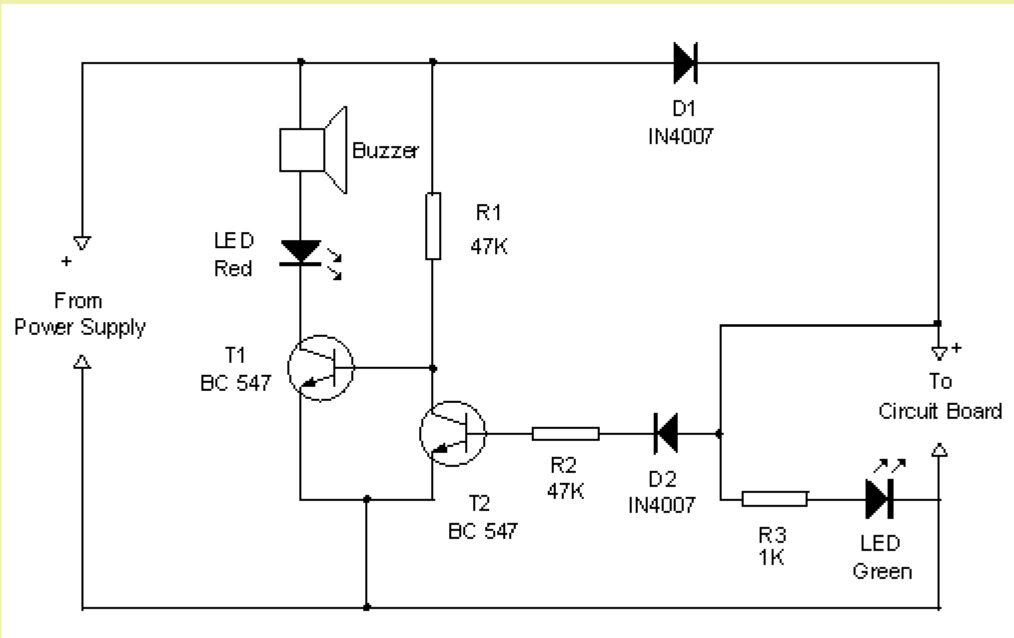
overlay, no solder mask and only bare copper tracks.
I was the first to introduce tinned tracks, a component overlay identifying all the components, as well as the name of the project.
Every magazine in the world does this, except EFY !!!
This project is signed: "Tested by EFY" Where are the test results? Where is the photo of the completed project?
You can fool half the people half the time. But you cannot fool all the people ALL THE TIME. Sani Theo and Rahul Chopra have not answered any of my questions including: Why use 5v relays when 12v relays are more common, cheaper and available in 20 amp contacts - especially in India. And the current-rating for the relays is not mentioned in the text. You have to work that out FOR YOURSELF. This is another untried, untested project containing a myriad of problems. All of which have remained UNANSWERED.

Here's another useless circuit from http://www.electroschematics.com and D Mohankumar

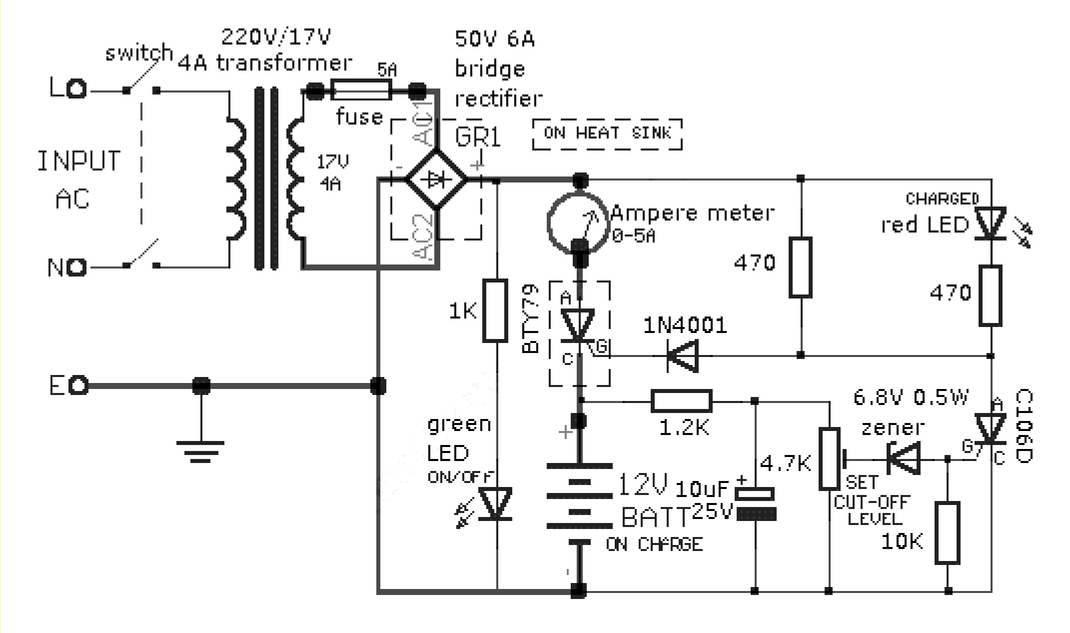
Here is the RUBBISH from D Mohankumar, describing the operation of the circuit

Here is a valuable add-on circuit to save valuable electronic components in the assembled board from damage. It gives a warning beep if there is a short circuit in the assembled board. Thus it helps to switch off the power supply immediately to save the components.

When there is a short-circuit on the PC board you are testing, the voltage on the output pins will be zero.
This means all the current from the power supply will go through the 1N4007 diode and into the PC board and damage the components. The circuit will not provide protection.
Secondly, the voltage of the power supply will drop to less than 1v and the buzzer will not work.
The circuit is a Total DISASTER. Why doesn't he test his circuit before putting them on the web????



BATTERY CHARGER



This project contains a number of mistakes.
A 17v AC transformer will produce a peak of 17 x 1.4 = 24v and when this voltage is delivered to a 12v battery, the current will be enormous.
The 5 amp fuse will blow immediately.
The circuit DOES NOT WORK.
The second problem with this type of circuit is the CUT-OFF.
As soon as the voltage across the battery reaches the cut-off voltage set by the 4k7 pot, the circuit will turn off and remain OFF. It may turn on again when the battery voltage decreases, but this lower point is unknown.
The purpose of the 470R is to provide sufficient gate current to turn ON the thyristor. The thyristor needs about 25mA gate current and this will occur when the rail voltage is about 6v higher than the battery voltage.
This means only about 40% of each cycle will be delivered to the battery, however the losses in the transformer will be considerable and it will get very hot.
The circuit has no trickle charge feature and it will be very difficult to set the upper voltage and make sure the battery is fully charged.
The circuit should have a bypass resistor to allow a trickle charge current of 50mA to 100mA.

Here's another fault from the circuit above:

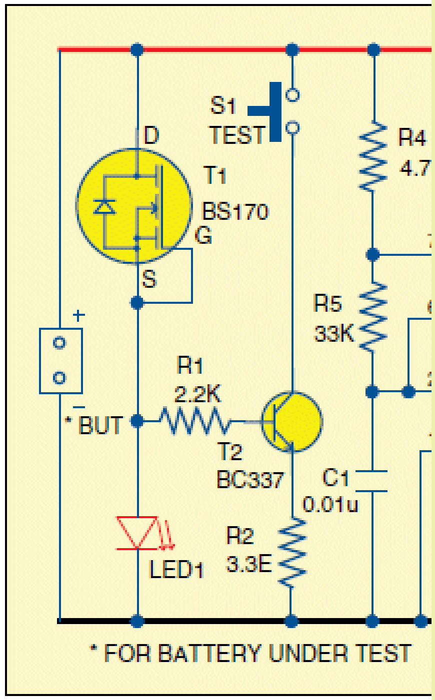


Fig. 1: Circuit diagram of the battery tester

The circuit puts a load on the battery under test of 120mA. This current flows through the BC337 and 3R3 resistor.
The 3R3 drops a constant voltage of nearly 0.4v, for any battery under test, and all the rest of the voltage is dropped across the transistor. For a 12v battery under test the wattage dissipated in the transistor will be 11.6 x 0.12 = 1.4 watts !!! The transistor is a 600mW device !!
Another stupid circuit by EFY.
No-one on the technical staff of EFY has the BASIC ELECTRICAL and ELECTRONIC knowledge to spot these mistakes.
If the magazine was a mathematical magazine and contained lots of mistakes, you would LAUGH !!
You should NOT be reading the magazine. The information they deliver is FULL OF MISTAKES.
Fortunately I monitored the magazine over a period of 6 months and found NOT A SINGLE PERSON built any of the circuits and that's why no-one else has picked up any of the mistakes.
They are so desperate to sell their magazine that they offer a gift with each subscription EQUAL to the the value of the subscription.
It's a bit like POPTRONICS in the USA. They offered 12 months for $19.95. The subscription agency received $6.95 leaving $12.00 for 12 issues. The cost of printing was 50 cents and the cost of posting 50cents. Leaving NOTHING for the production of the magazine.
Talking Electronics website gets 7,000 visitor each day. This is more than any of the electronics magazines (on a monthly basis) and it is FREE . . without having to look at pages of irrelevant advertising.
All the popular magazines are available for FREE download in the web and after you skim through it, you wonder why you would ever spend $7.00 on a paper copy.
I cut up 10 years of electronics magazines and only kept the articles. I reduced the pile to less than 5%.
One day I will scan the pages and put them in a .pdf. Many of the articles are very informative but most of them can be reduced to a single microcontroller and that's why they are so out-of-date.

This "NASTY" circuit has been taken from **ELECTRONICS FOR YOU** May 2014:

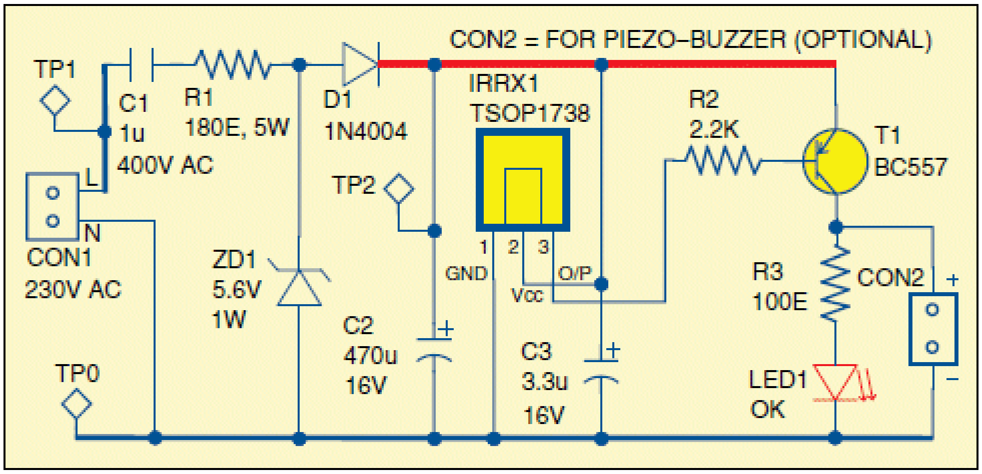


Fig. 1: Circuit diagram of the remote control tester

It uses the MAINS to derive 5v for the module to test IR remote controls. I have already mentioned that you can use a camera pointed at the end of the remote control to view the IR LED and this will save you building any circuit.
But this circuit is a DISASTER. It uses the mains to derive a 5v supply. It would be much easier and safer to use 3 x AAA cells.
This type of supply is BANNED from publication in hobby magazines in all WESTERN COUNTRIES and it about time INDIA stops promoting this type of supply.
D1 is not needed as the 5v6 zener produces the 5v supply. Use 5v1 and omit the diode. The zener does not have to be 1 watt. It only needs to be 400mW
What is the purpose of the 3u3 when the power rail already has 470u !!!!
The losses in the 180R resistor will be MORE than 5 watts!!!!
Another badly designed **DANGEROUS** circuit from EFY.

Here's another STUPID circuit from **ELECTRONICS FOR YOU** May 2014:

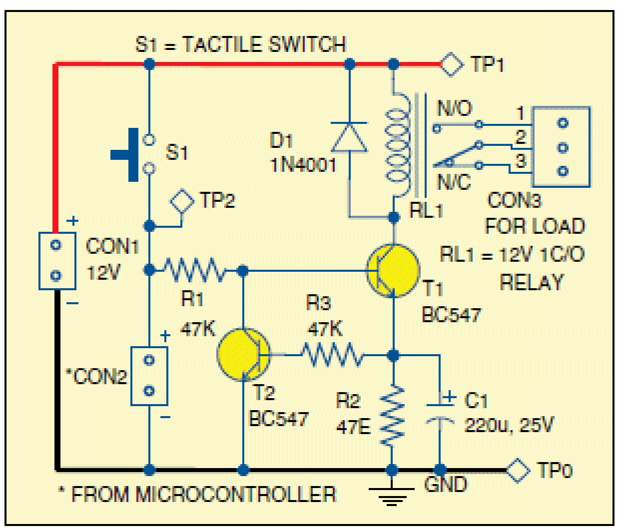


Fig. 1: Circuit diagram of the power-saving relay driver

The circuit is designed for the relay to take less current due to the constant current arrangement of the two transistors.
But the 47k resistor R1 will not deliver sufficient current to turn ON T1. The simplest way to determine the effectiveness of a resistor on the base is to allow a gain of 100 for the transistor. This means the value of the resistor is 47,000/100 = 470 ohms. The transistor becomes a 470 ohm resistor in series with the coil of the relay (400 ohms) and it will get only HALF-RAIL VOLTAGE !!!!!
This can be worked out another way. 5v from a microcontroller will deliver 5/47,000mA = 0.106mA
If the transistor has a gain of 100, it will deliver 10.6mA to the relay. The relay needs 30mA to PULL-IN.
Another untried, circuit from EFY.
By using my first method of calculation, I could instantly see the circuit did not work. That's how you quickly diagnose a circuit.

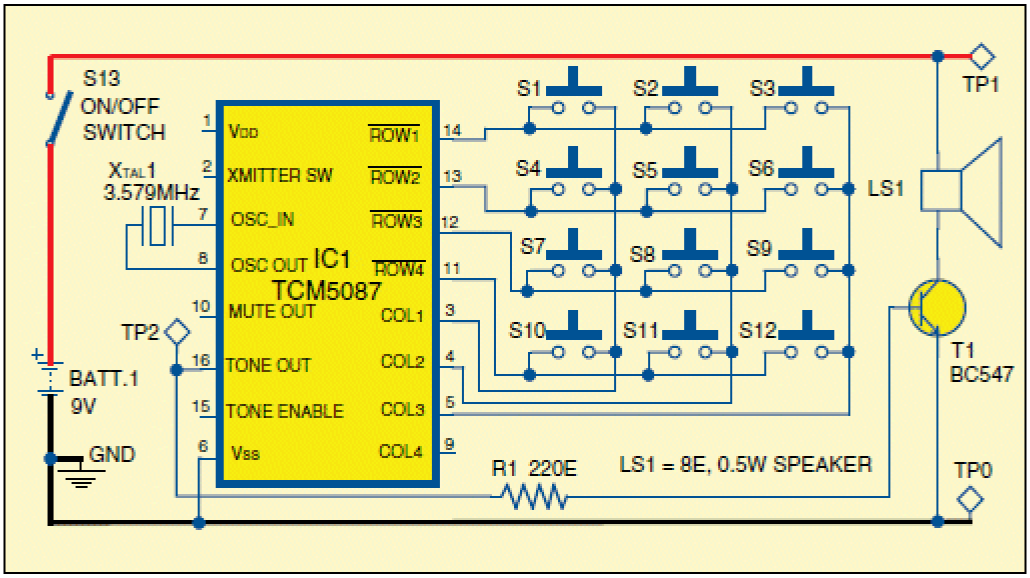
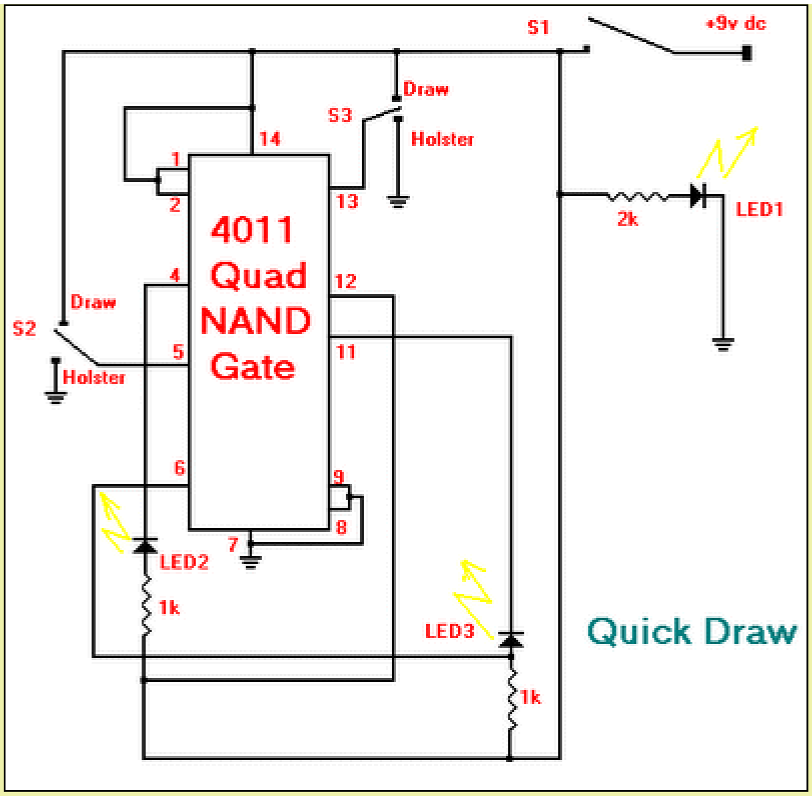


Fig. 1: Circuit diagram of the touch-tone dialer

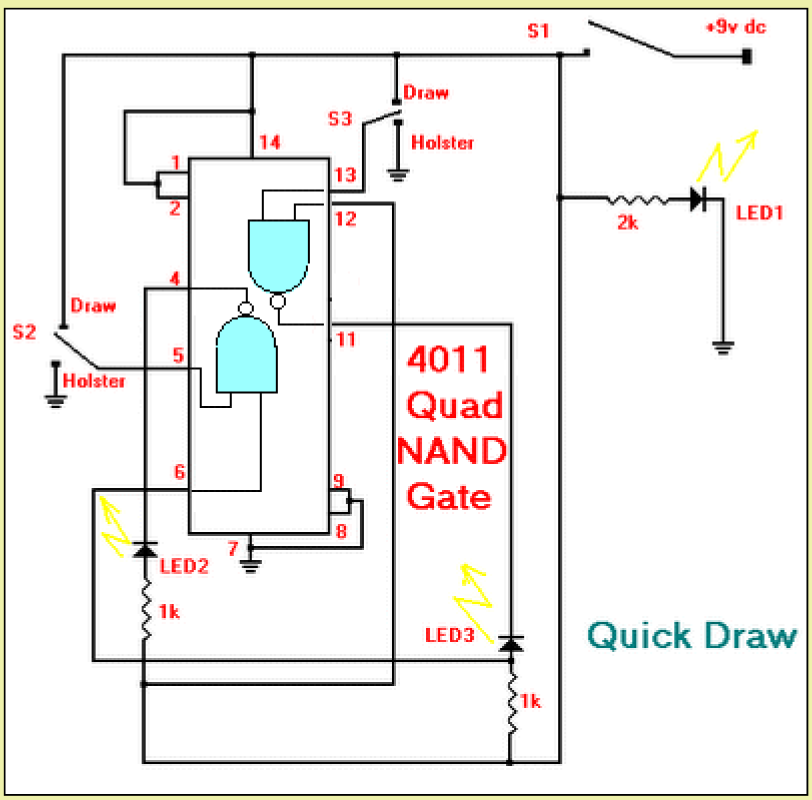
Instead of making the circuit above, just get a $10.00 TOUCH-TONE phone and connect it to a 12v battery via a 47R resistor.
Push the keys and listen to the tone in the earpiece.
If the tones are not loud enough, put a speaker on the positive line or add an amplifier.
EFY would be much better-off by telling the readers how to make something SIMPLE and not produce a complex circuit, just to fill the pages of the magazine.

Why aren't there any mistakes from English, US, Australian or German magazines, in this list ??
Simply because they don't make STUPID mistakes.
If anyone finds a mistake, please send it to: Colin Mitchell. It will be included in these pages.

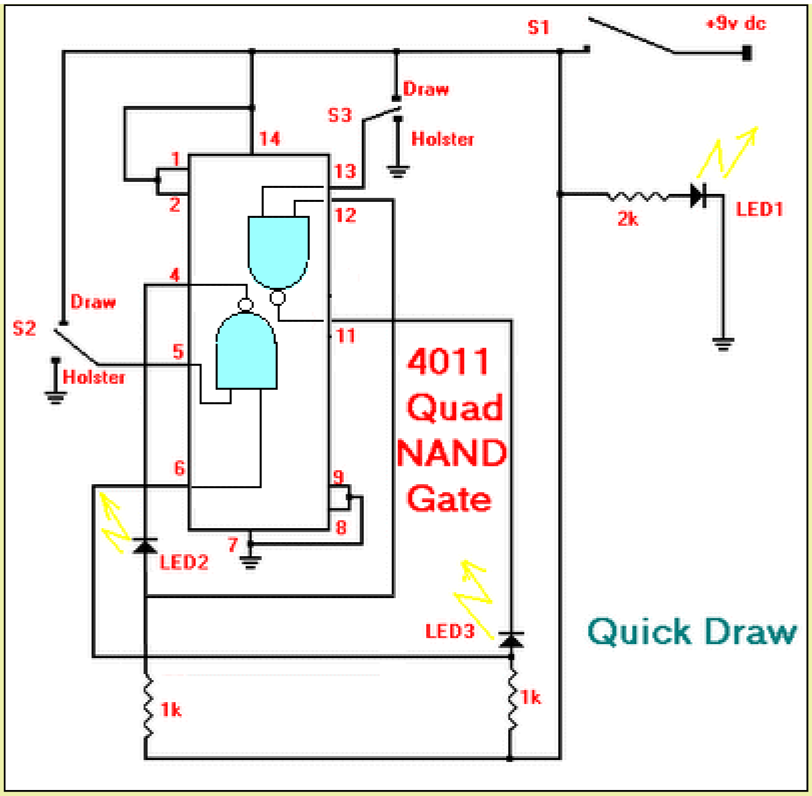
How many times have I said "NOT TO DRAW BLOCK DIAGRAMS"
Here's a perfect example.
I could not determine how the circuit works from the following drawing:



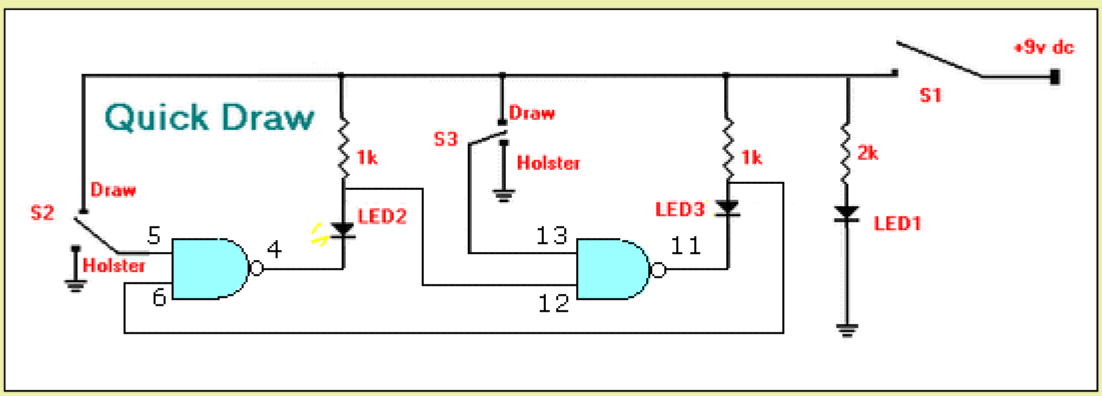
I then added the gates:



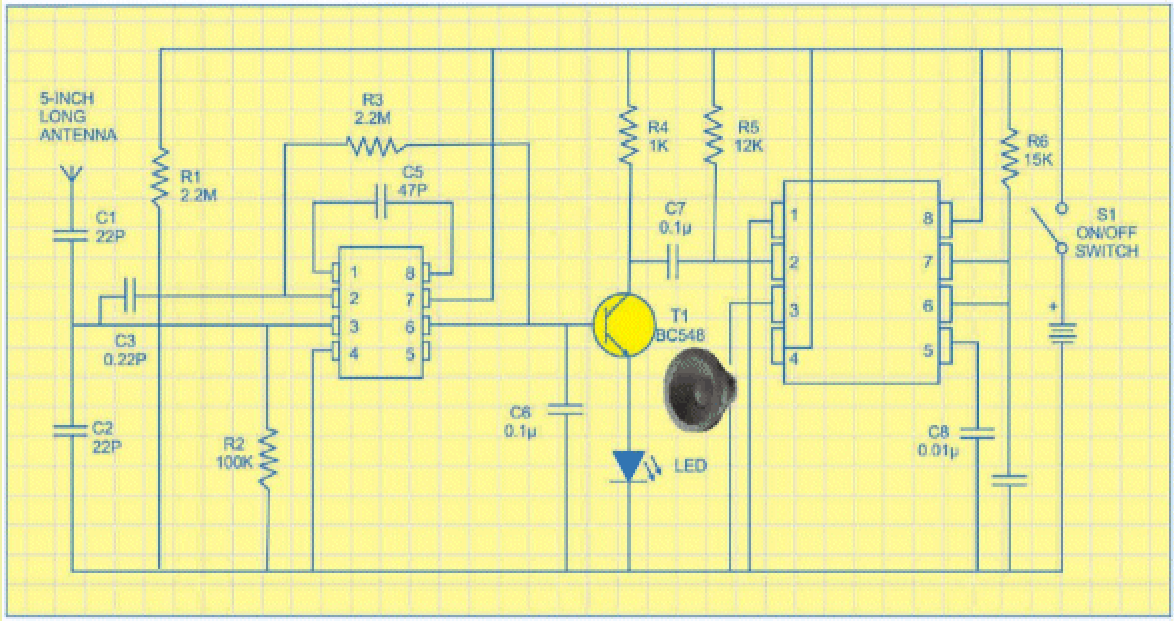
From the diagram above, I saw the circuit DID NOT WORK.
Here is the correct circuit:



By drawing the circuit using GATES, you can clearly see how one gate prevents the other gate from activating its LED:



Here's another junk circuit from **Electronics Maker** magazine.
Parts are incorrectly identified, some components are not identified and it appears that a speaker is connected directly to pin 3 of the 555 IC (not identified on the circuit) while the supply is a miniature 12v lighter battery!!
The 0.22P is identified as 0.22u (220n) in the text but the other values are unknown.
The magazine simply has **NO electronics capability** what-so-ever and that's why the Indian student cannot rise above the stage of "tinkling around."



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SPOT THE MISTAKES!

Page 21

Writing about the mistakes on the web and getting "stuck into" faults in text books, makes you wonder what should be covered in a 3 year course on electronics.
If I had my way, the course would start 10 years before, with the encouragement to build at least one project a week and get it to work.
I have proof from thousands of readers who have built the kits from Talking Electronics Magazine, that electronics can be learnt by CONSTRUCTION.
First of all, it is a much-faster way to learn and if you account the costs of a course, it is CHEAPER.
I have talked to students after a 3 year course who "Don't do soldering."
I have University Professors who say you can achieve 3v on the base-emitter junction of a transistor or who cannot draw the simplest circuit from memory. Or cannot properly explain how a transistor amplifies.
I have seen graduates of an electronics course who have hardly constructed a single electronics project.
If you look at most of the courses, they consist of stale, uninteresting, irrelevant material such as making an XOR gate out of other gates or half-adders.
Show me one project or product using this and I will give you $10,000. Any product needing timing or logic gates will use a microcontroller. A flashing LED uses a microcontroller. A whistle-keyfinder uses a micro and these cost 10cents in a $2.00 product. They use a microcontroller because it is cheaper than using discrete components.

You can buy a fully pre-programmed PIC chip "die" for 6 cents. Obviously this is a price (within China) for a special MCV08A (which is a much-better version of the PIC12F629) that has been developed especially for China. China has already ordered over 30 BILLION PIC chips - mainly in

the form of a COB for all sorts of devices, including toys and this technology/pricing has not been released to the external market. We are still paying exorbitant prices for a PIC chip (33 cents to 80 cents),

These courses need to update their content and concentrate on modern materials, chips and circuitry that will be needed for present-day designs.
It should revolve around small, medium and large microcontrollers.
Then cover building blocks to interface to these devices.
Then cover chips that perform specific functions.
With this information, the student can emerge with the knowledge to design much of the equipment for auto, health, domestic and recreational use.
In these days of high expenses for each week of study, it is pointless covering topics that "bit the dust" 10 years ago.
But this is all the lecturer knows. That's why he keeps re-gurgitating it to the class.
One of my friends is teaching SOLAR INSTALLATION and none of the other lecturers know anything about the subject.

YES. I am saying the complete opposite of a University course is the ANSWER.
It's a pity mere practical skills are not recognised. The paper degree is the almighty power.
That's why you have to bow to the powers of the recruiting officer and follow both paths, Knowing your ability comes from experimentation; and access to the "job Market" comes from your "CV."
You have to feel competent and capable within yourself and this comes from actual construction and testing.
This way you won't make a fool of yourself and undertake a project way beyond your capability.

There's an old saying:
If you can: DO
If you can't: TEACH

The whole concept of Talking Electronics website is to explain electronics to electronics enthusiasts who want to learn electronics but do not want the mathematics.
It would be wonderful if all electronics enthusiasts understood complex mathematical notation, but this isn't the case.
The two understandings are diametrically opposite to being successful and it's a bit like expecting all stunt-car drivers to be able to do tricks on a unicycle.

Now you can see what I mean.
The wonderful part of electronics allows you to build a circuit and take "real-time" quantities and CRO observations.
These far-outweigh any hypothetical, calculated or simulated results.
The biggest problem with any new design is getting the circuit to work.
No simulation-software or text-book is going to help you.
That's why all the year's spent on the mathematical approach is going to get you down.
The only way to learn electronics is from the bottom-up. Not from the top-down.
I know this is a radical approach, but you should learn the mathematics AFTER you have built and studied hundreds of circuits. The mathematics only makes sense afterwards.
Do you know why this is not done?
Because if you build a circuit and it does not work, 99% of the instructors will not be able to diagnose the fault.
Talk is cheap. Anyone can stand in front of a blackboard and churn out notes. The real skill comes from diagnosing a circuit and pinpointing the fault.
I am personally against trying to work out the operating point of a circuit and current values because all the values used in the equations are "GUESSED."
You have absolutely no idea of the current-gain of the transistor you are using as any batch has a range that will either be double or half the guessed-values.
Why spend time working things out mathematically when the circuit will have to be constructed and final values determined after seeing the results on a CRO.
But the biggest absurdity of most courses is the lack of basic content. The lessons cover circuit analysis without covering any of the details of circuit-design.
If you look at our eBook: The transistor Amplifier you will see over 100 circuits on designing a simple transistor amplifier.
You cannot possibly go into analysing a circuit before learning how to design a circuit and build at least a dozen or more circuits to see how they perform.
That's why University graduates emerge from a 3-year course without ever touching a soldering iron.

One of the most important topics is INTERFACING. Connecting a microcontroller to the outside world. Or interfacing ANYTHING.
Normally this involves BUFFERING the output to drive a high-current load but it can also involve an input stage to amplify a low voltage transducer.
There are also a number of other BUILDING BLOCKS that use transistors: such as oscillators, constant-current circuits, filters, etc and covering these is much more important than analysing an amplifier with lots of mathematics.
These courses still have a long way to go and there are hundreds of "tricks" to designing that I have covered in the eBooks on this website. None of these have ever been mentioned in any class notes.
Anyone finishing a course will be be making a complete fool of themselves by falling

into simple traps that apprentices have already discovered.
That's why this website gets 7,000 visitors each day. They keep coming back for more.
That's why you are reading this topic.
You will learn MORE in this topic than in anything anywhere else.
You learn more from other peoples mistakes - and also from your own mistakes.
And that's the factor that is missing from all the text books. They never tell you what will happen if you use higher or lower values or what will happen if a component is missing or goes faulty.
That's why teachers have no experience in fault-finding a students work.
That's why they don't promote the idea of building things !!

Here's an example of what I am talking about:

I've bought an industrial pedestal fan but even its lowest speed is far too windy and noisy for my use.
The voltage is 240, at 50Hz. The fan is 200W. How can I slow it down?

For a 200 watt fan, full load current = 200/240 = 0.83 Amps.
To drop 100 volts at 0.83 amps, you need a capacitive reactance of 100/0.83 = 120R.
The reactance = 1/(2 x Pi X freq X C) so
C = 1/ (2 X 3.14 X 50 X 120)
C = 26.54 uF

The answer above has a major mistake. The current will not be 0.83 amps when the capacitor is included. It will be 0.42 amps.
A 100n capacitor will pass 7mA at 240v and only 3.5mA at 120v.
To pass 0.42 amps will require 120uF.

Using the correct figures for the equation above:

For a 200 Watt fan, full load current = 200/240 = 0.83 Amps.
To drop 120 volts at 0.42 amps, you need a capacitive reactance of 120/0.42 = 285R.
The reactance = 1/(2 x Pi X freq X C) so
C = 1/ (2 X 3.14 X 50 X 285)
C = 112 uF

If the respondent to the question had built a capacitor-fed supply, he would not make that simple mistake.
That's why construction is so important.
You will notice I have provided an alternative approach to the MATHEMATICAL APPROACH. It's

very important to approach a problem in two different ways so you can back-up your answer.
This is the point I am trying to get across.
I am providing a second-approach to everything you are doing, so you don't make a fool of yourself.

Here's another incorrect response to a question in an electronics forum:

Is there any device or component that can clamp 200V to 25V for 200ms without failure?

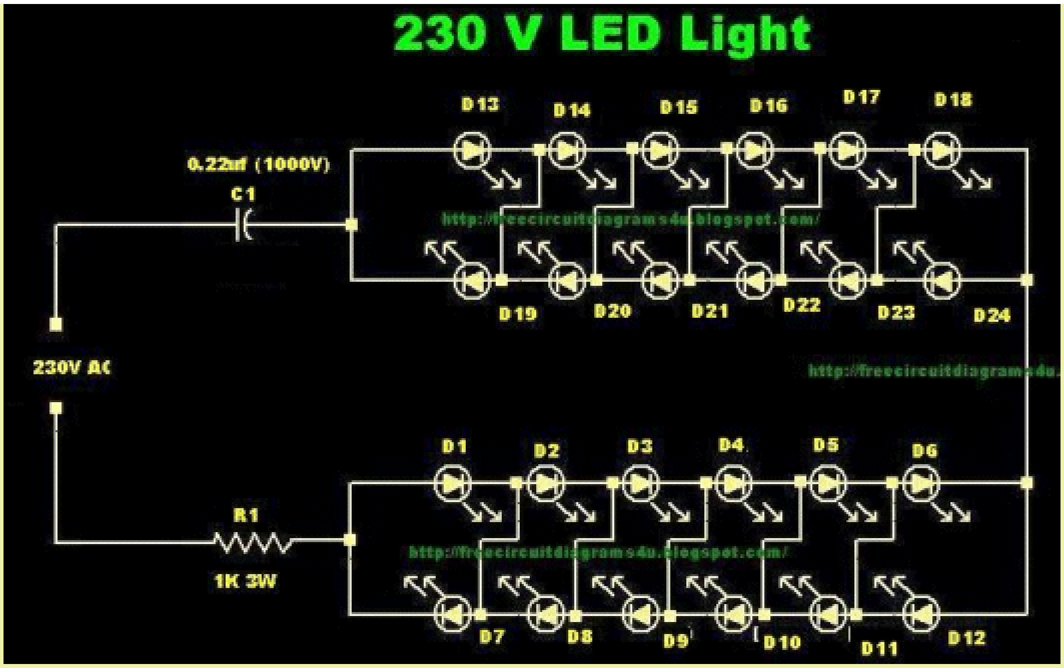
Reply:
Loading the output WILL generate heat and 1/4W resistors just wont cut it.. you will need to get 20W or higher resistors..
Quick calculations..
1K resistor = 40W power dissipation = 35W in the resistor & 5W in the Zener(Max according to its Datasheet)
2K resistor = 20W power dissipation = 17.5W in the resistor & 2.5W in the Zener (bit better, with room to breath)
However at 1mA measured load (25V supply) the Vdrop in the Resistor is 2V giving you 23V output.. (and at 10mA it's 20V, giving you 5V output) ...

The above is absolute RUBBISH.

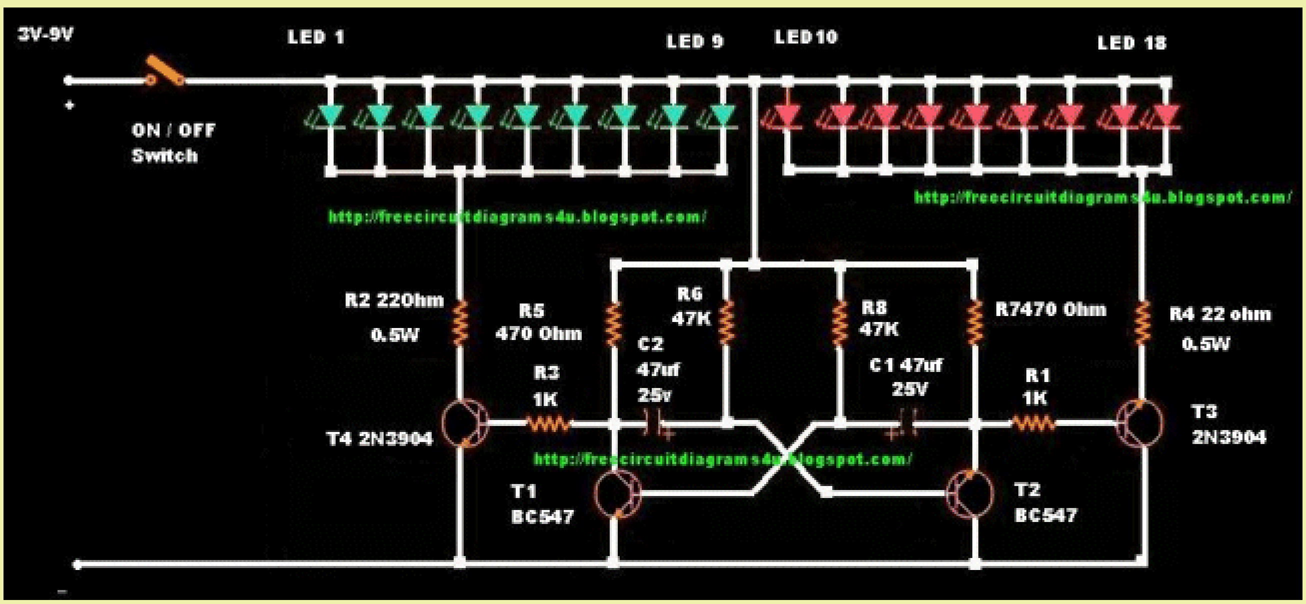
You just need a 24v 400mW zener diode and a current-limiting resistor. The zener will breakdown when a minimum current flows and as the voltage rises from 0v, a low voltage will appear across the diode. As the voltage rises, this voltage will appear at the junction of the diode (zener junction) and it will not rise above 24v.
There is a certain amount of leakage across the junction and the voltage will not rise to 24v until a few milliamps flows.
The value of the current-limiting resistor is worked out by knowing the minimum current required by the zener and
the data sheet specifies this as 5mA.
This means the current-limiting resistor will have 200 - 25 = 175v across it.
We do not know the the source of the 200v and some assumptions have been made when making the following calculations:
If we want a 1 watt current-limiting resistor, it will need to be: 1 = (175 x 175)/R = 30,625 use 33k resistor
We don't know if the voltage is AC or DC but about 1 watt or 2 watt will be sufficient.
Certainly NOT 20 watt to 40 watt !!

The original poster has now stated the source of the 200v spike is coming from the coil in a coin comparator and we can state the current and waveform will be so small and short that almost no energy will be delivered. This means a 0.25 watt resistor will be suitable.
Furthermore, it is not recommended to put a zener directly across the coil as this will inhibit the operation of the coil and prevent the received signal providing the correct information.
Also we have not been told if the 200v signal is produced by the coil when it is collapsing or if it is a fault in the energising circuit.
You cannot simply put a zener across the coil to limit the flyback (in the same way as a diode is placed across a coil) because a zener is just like an ordinary diode but with a PIV of a very low value.
If you use a zener, it will have voltage of 0.6v in one direction and 24v in the other.
This is simply not going to work.

Here is a 240v LED Light:
The problem is only half the LEDs are illuminated at a time. This means you are using twice as many LEDs to get the same brightness !!!!

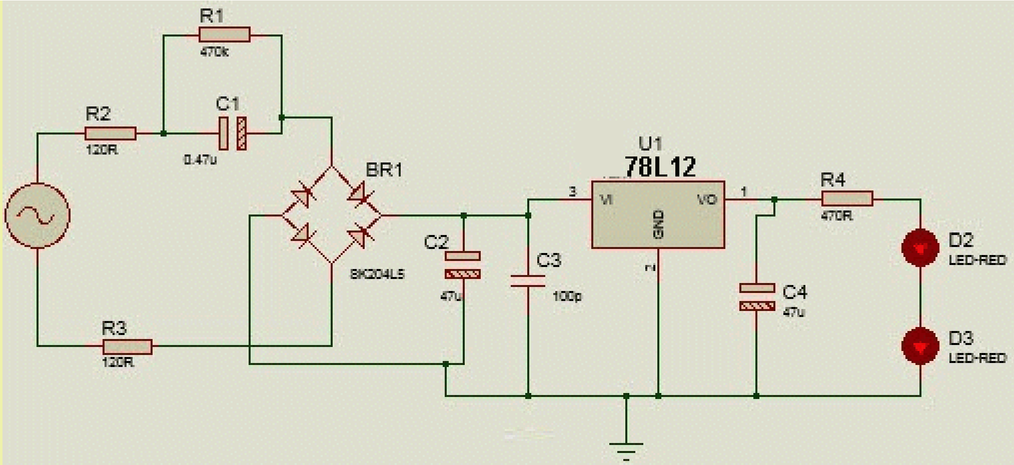


CHRISTMAS STAR



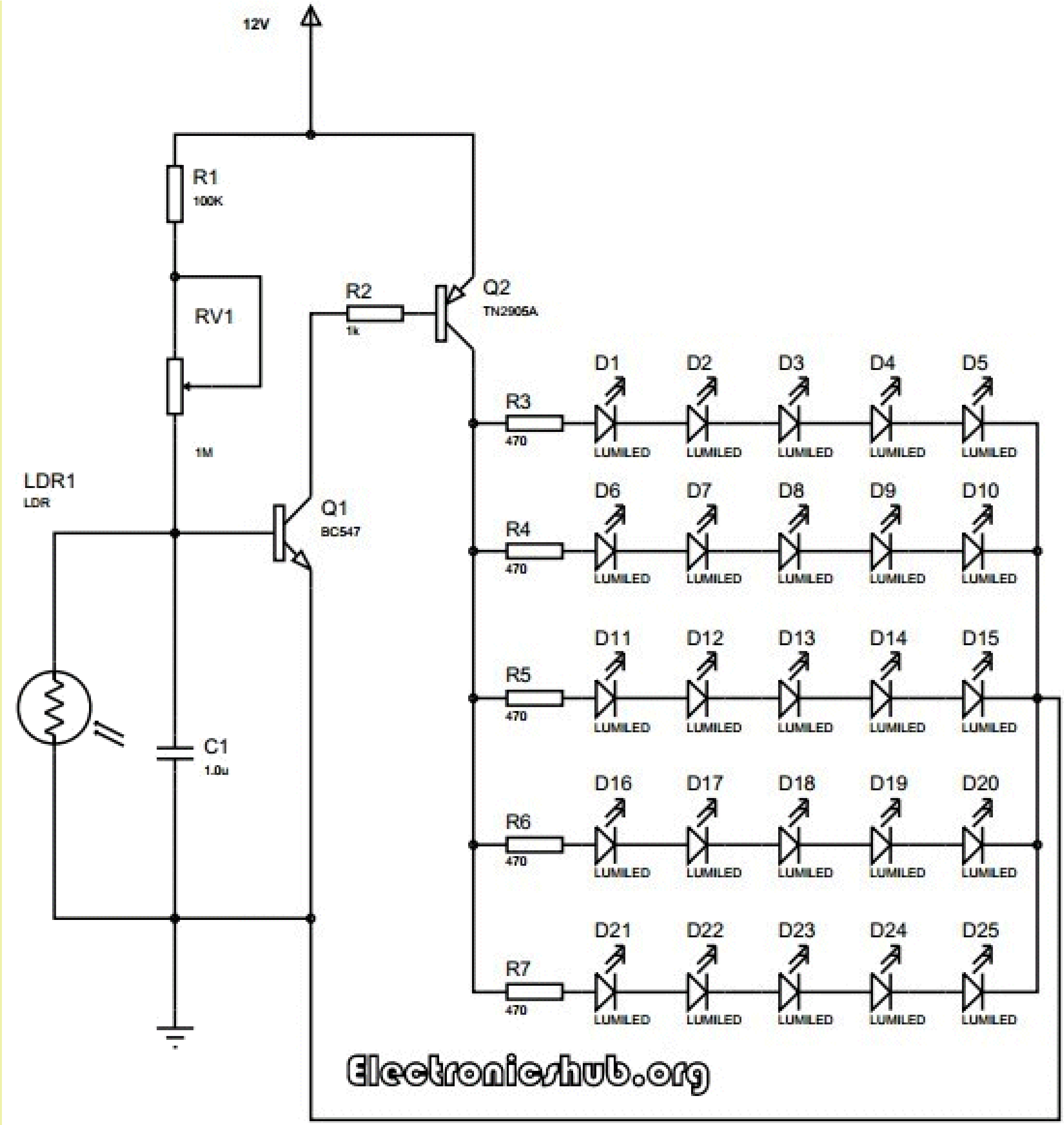
The current through the 220R will be: 7v/220 = 31mA
There are 9 LEDs. Each LED will get 3mA !! Not very bright !!

You cannot connect a regulator to a capacitor-fed power supply. (it is pointless - "waste of time")



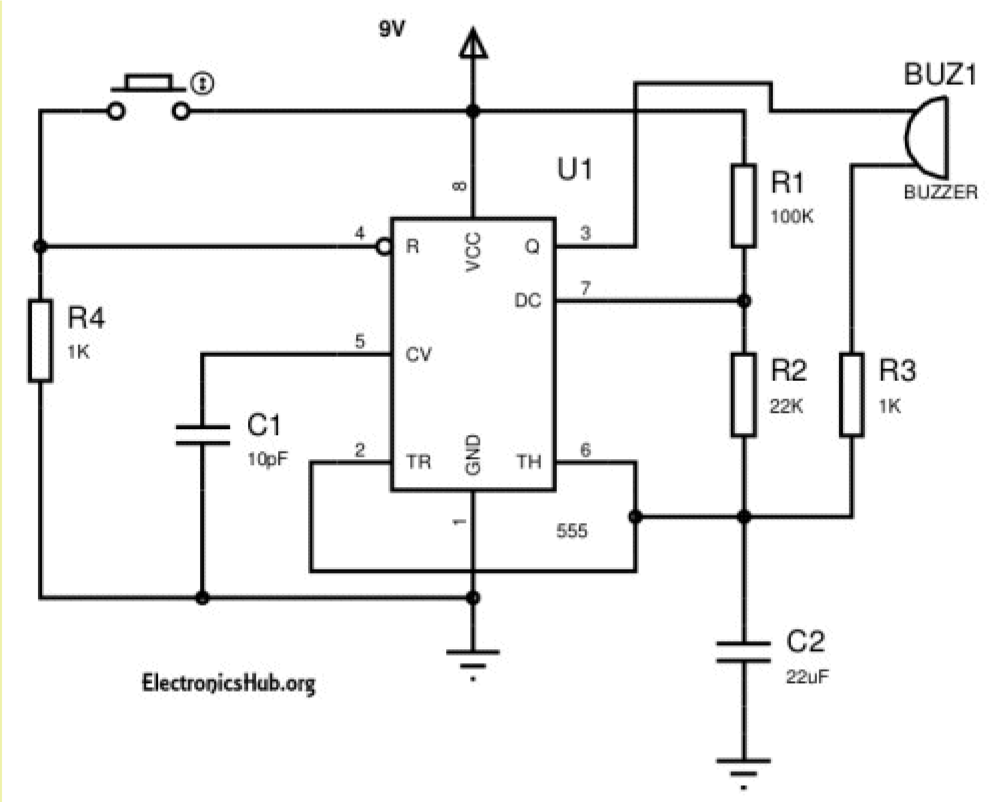
Here's the reason:
The output of the 78L12 will be 12v. The current through the 470R will be 12v - 4v = 8v. = 8/470 = 17mA
The 78L12 takes about 3mA so the input current to the regulator will be 20mA.
The output of the power supply will be 7mA for each 100n of C1 = 33mA The voltage on the input of the regulator will rise until it takes 33mA.
The maximum input voltage for the regulator is 35v.
The voltage will keep rising until the regulator takes 33mA and when the voltage reaches 35v, the regulator component will explode.
You have to understand how a capacitor-fed power supply works. It is not like a normal power supply.
We have covered this in the 30 LED Projects section.

Here's another junk circuit from **ELECTRONICSHUB.ORG**



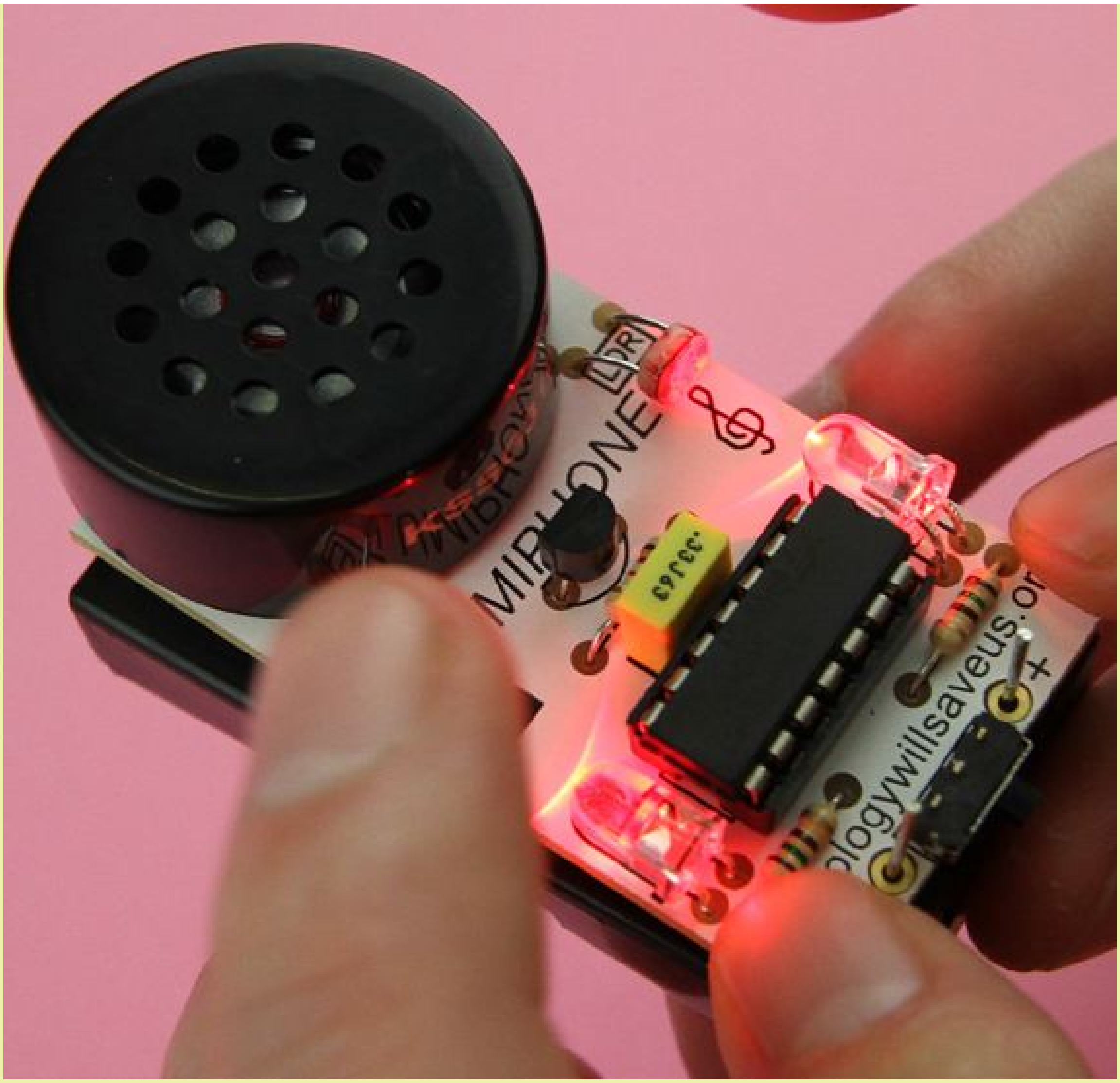
The LUMILED's drop about 3.6v each. 3.6v x 5 = 18v. The supply is only 12v !!!!!!
The circuit has never been tested !!!!

Here's another junk circuit from **ELECTRONICSHUB.ORG**

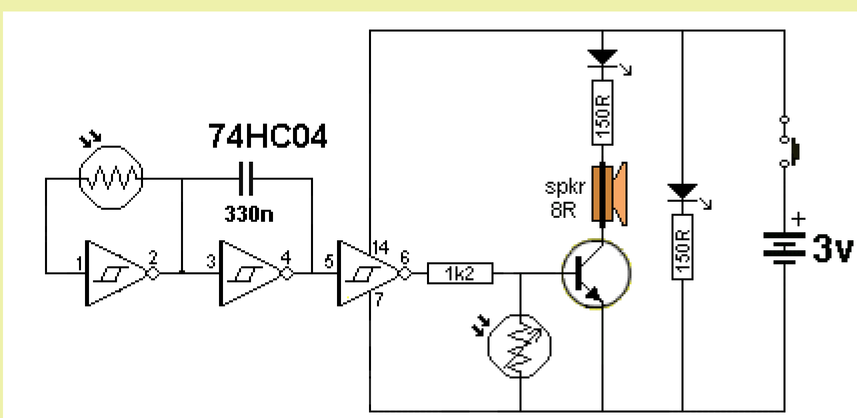


The circuit consumes 10mA when sitting around doing nothing.
The switch should have been on pin 8 and 4.

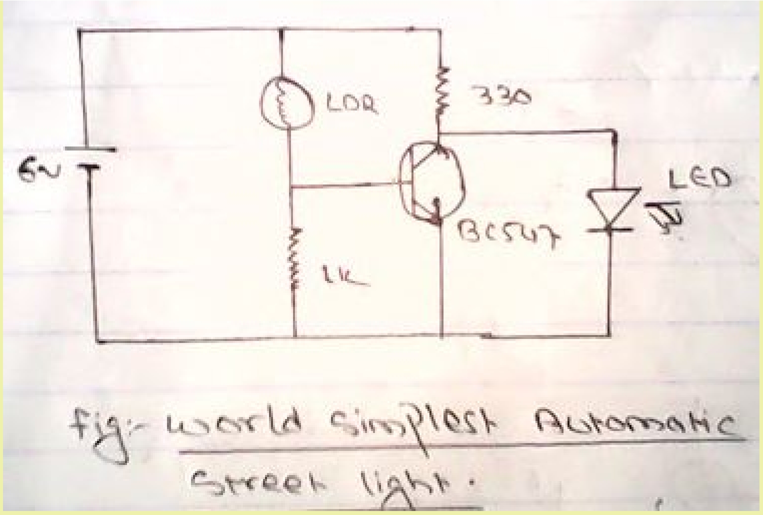
Here's a project from **Makers Shed**.
Makers Shed is supposed to assist you in building things. But this project, along with the other projects they sell, has no circuit diagram and a very high price-tag. The kit costs $17.00 and the postage is $21.00.
Makers Shed states: **New Fun Kits from Technology Will Save Us! I don't think $38.00 will save us !!**



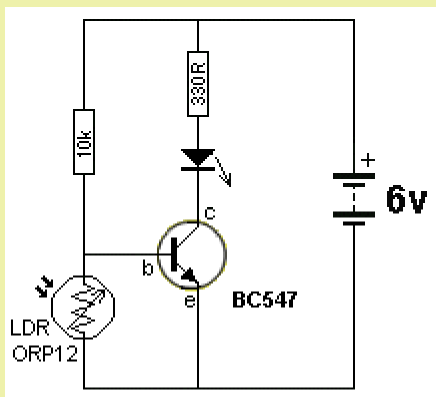
Here is the circuit diagram, generated from the pictures of the circuit board:



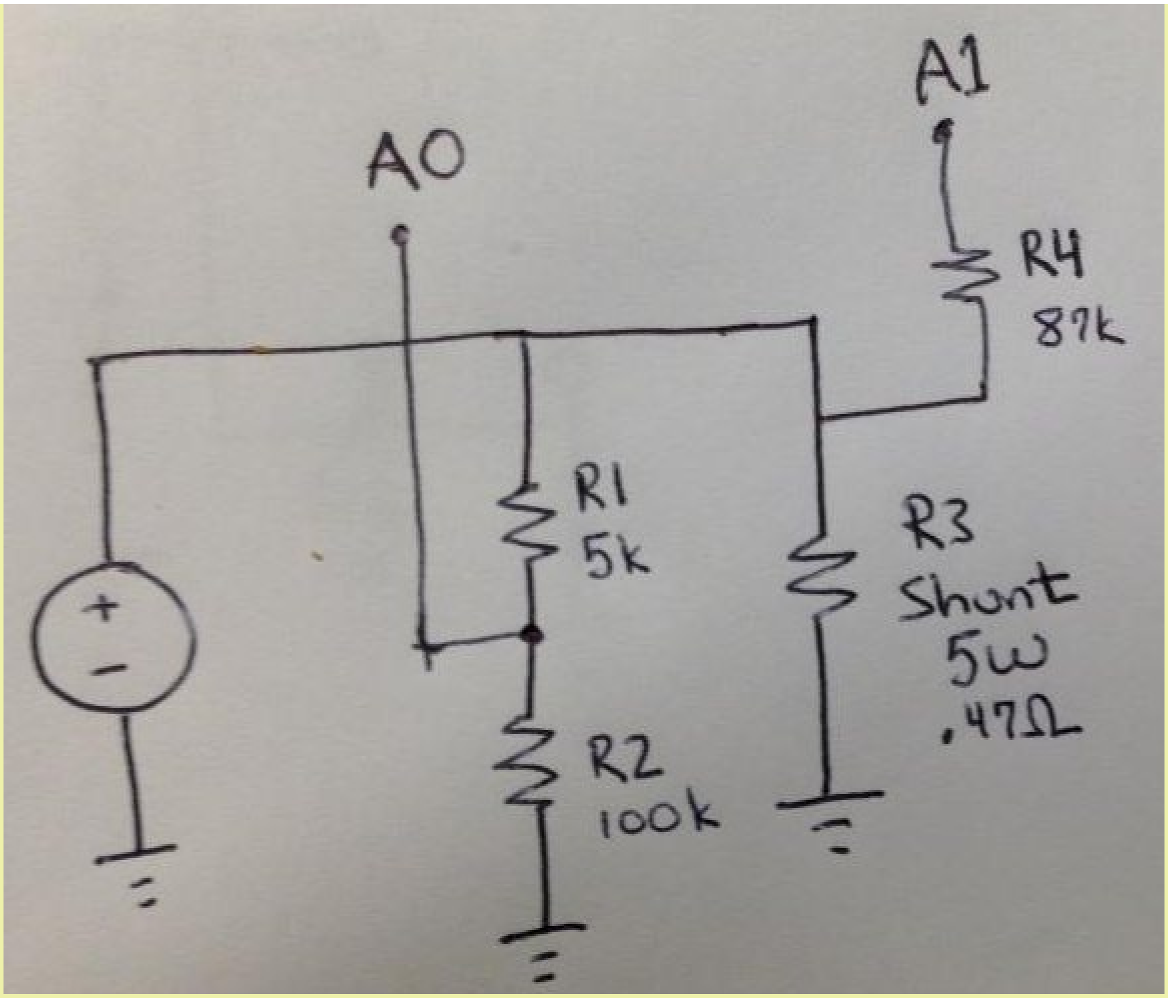
This is a really STUPID circuit:



More current flows when the LED is not illuminated because the transistor is diverting the current and WASTING It.
When light falls on the LDR, the transistor is turned ON and current flows through the collector-emitter of the transistor and turns OFF the LED.
The following circuit takes less than 1mA when not illuminated and the 10k resistor can be increased so the circuit takes less current.

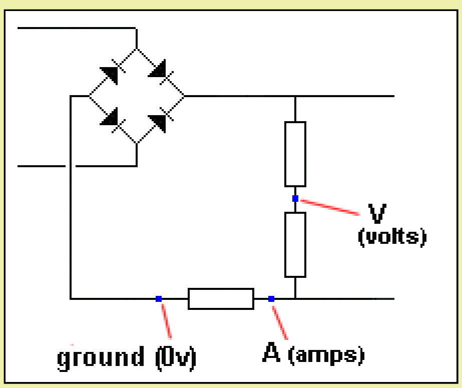


I'm trying to get real time data off of a rectifier by collecting it on a microcontroller and passing it to a computer. I am using a voltage divider to get voltage (A0 PIN) and the drop across the shunt resistor for current (A1 PIN). The problem is that when I apply rectifier I only get signal of the A1 PIN and no signal on the A0 Pin.



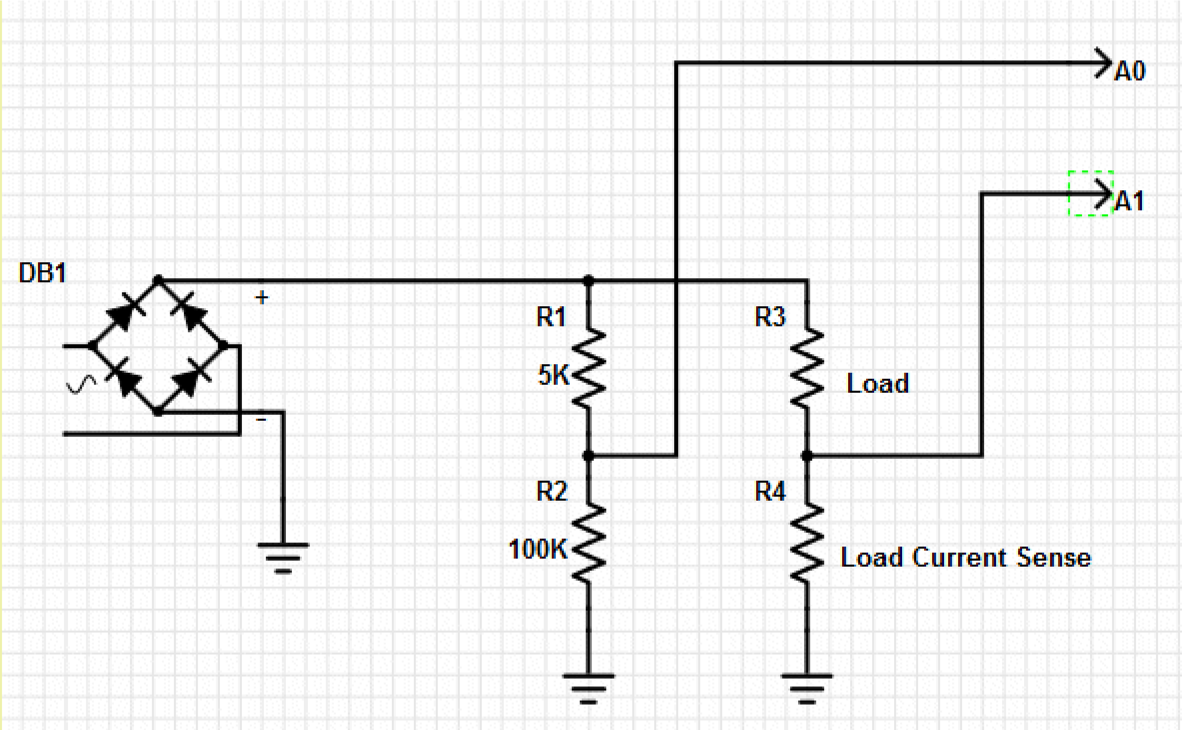
The poster on an electronics website is trying to produce a circuit that will monitor the voltage across a load and also the current.

This is the circuit required:



Here is answer from **STEVE LAWSON**:
Come to think of it, Colin’s circuit doesn’t make sense unless the voltage divider is also the load — otherwise what current are you measuring? Or to put it differently, why are we interested in the current flowing through the voltage divider— it’s merely for measurement purposes.
Steve Lawson doesn't understand the concept AT ALL.
The LOAD is placed on the output terminals and the shunt resistor monitors the current while the voltage divider resistors reduces the supply to a maximum of 5v so it can be fed into a microcontroller.

His further reply produced more lack of understanding:



This is a terrible circuit.
There is no reference point. The reference point is normally the 0v rail.
The voltage divider resistors are around the wrong way. You normally pick off a small percentage of the supply voltage.

I clicked on the banner above on an electronics website and found it went to a CYBER SQUATTING WEBSITE that wanted to sell the name for $2,000 !!!!
You can buy silconkits.com website for $15.00 from Godaddy for 2-years.
There is nothing I hate more than cyber squatters who demand outrageous prices for websites.
Fortunately a website name is not important as most visitors come to a site via a Google search.
It has put most of the cyber squatters out of business as they were charging up to $30,000 for names they thought would be essential for running a business.
The most USELESS, SILLIEST invention on the web turned out to be the most important factor in bringing it together: GOOGLE.
Without Google, the web would have been a total flop and ripe for fraudsters.

Here's a promotion from a PCB manufacturer:

Up to 64 sq. inches total (1625mm) PCB for $120.00

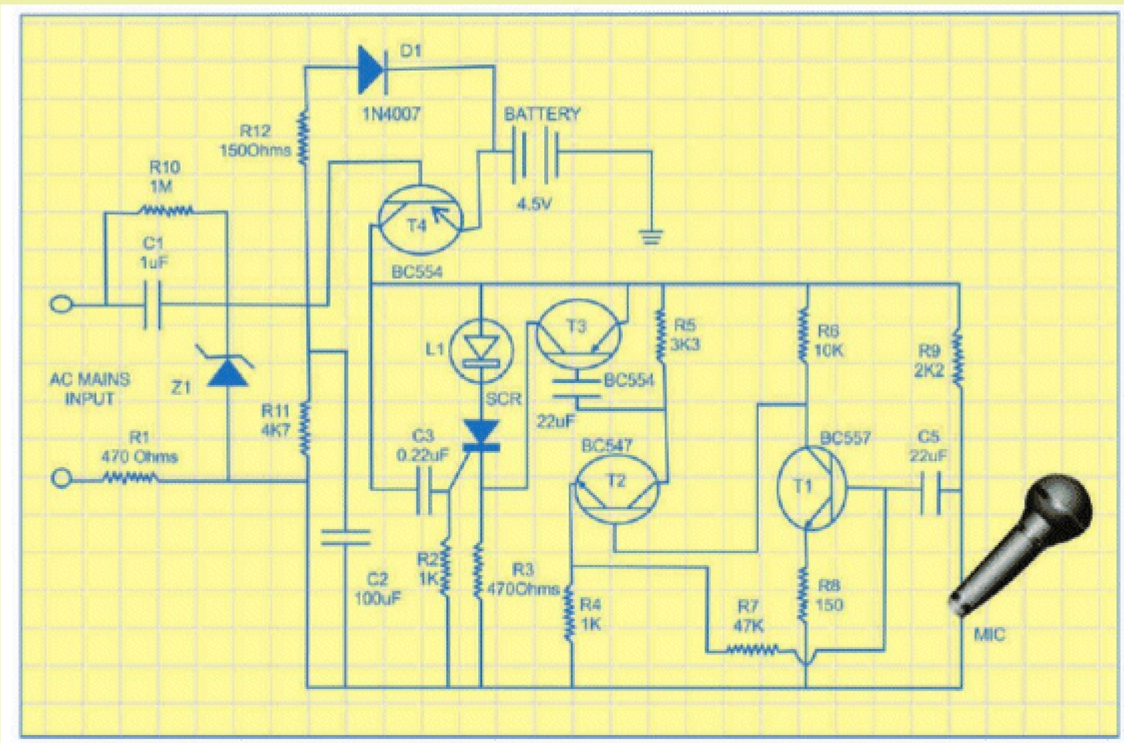
64 square inches is an area. 1625mm is a LINE with NO DIMENSIONS.

64 square inches is equal to 64 x 25.4 x 25.4 = 41,290 square mm (mm^2). or if it is say 8 inches x 8 inches or 20.32cm x 20.32cm or 412 square cm (cm^2).

If you can keep your PCB to within 100mm x 100mm, the cost of producing 10 boards is $20.00 including postage from: http://www.elecrow.com/ This includes double sided boards, 1.6mm green, HASL and only a single routing around the board. If you have two PCBs on the 100mm x 100mm, the item is called a PANEL and you have to allow 70 thou between boards so you can cut them apart yourself with a hax-saw and linish the

edges with sandpaper.
Both David and Martin from Elecrow provide assembly for your boards at amazingly low prices. 3 cents for each pad of a surface mount device plus $10.00 for set-up and $20.00 for a glue-stencil for surface-mounting. They will supply components for a minimum of 100 boards and this is quicker, neater and easier than trying to assemble the boards yourself.
Obviously you get a sample of 10 boards yourself and prove the circuit works. But after that, the production is left to Elecrow for an absolutely professional result.
Send a photo of your final project to us for inclusion in this article.
We are getting about 3 boards a week from Elecrow, as one idea generates another and you never run out of ideas.

Here we have the Indian magazine AGAIN, producing the most dangerous circuit on the market.
The neutral lead is connected directly to the microphone.
there will be very little insulation inside the microphone and if the mains leads are connected around the other way, the microphone will be 340v LIVE. Yes, the shock will be 340v. And if you are holding the microphone firmly, the shock will kill you.
This type of circuit has been banned from western magazines for over 10 years. It's about time the Indians stopped producing any type of capacitor-fed supplies as we have already covered their dangers.
All the circuit does is turn on a LED. It only needs a few parts to do this. NOT a circuit connected to the mains.



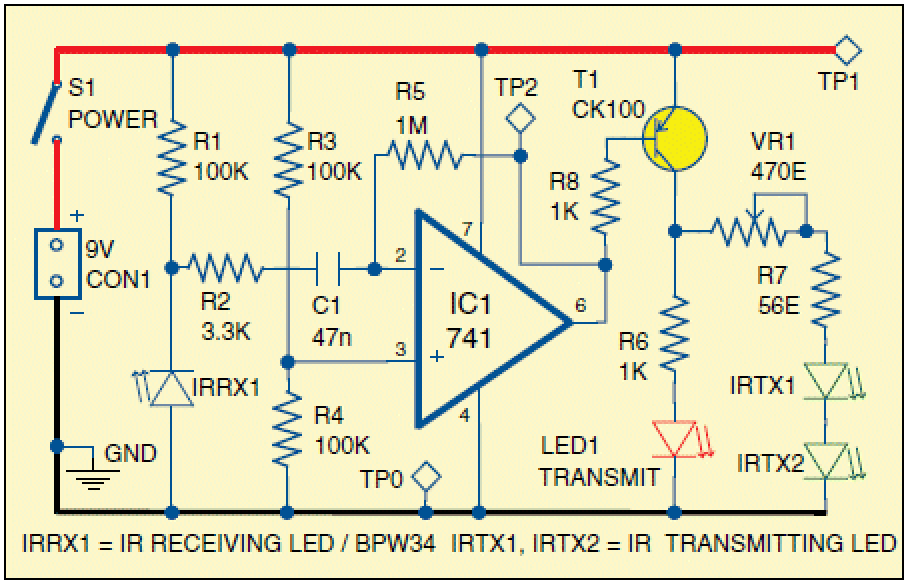
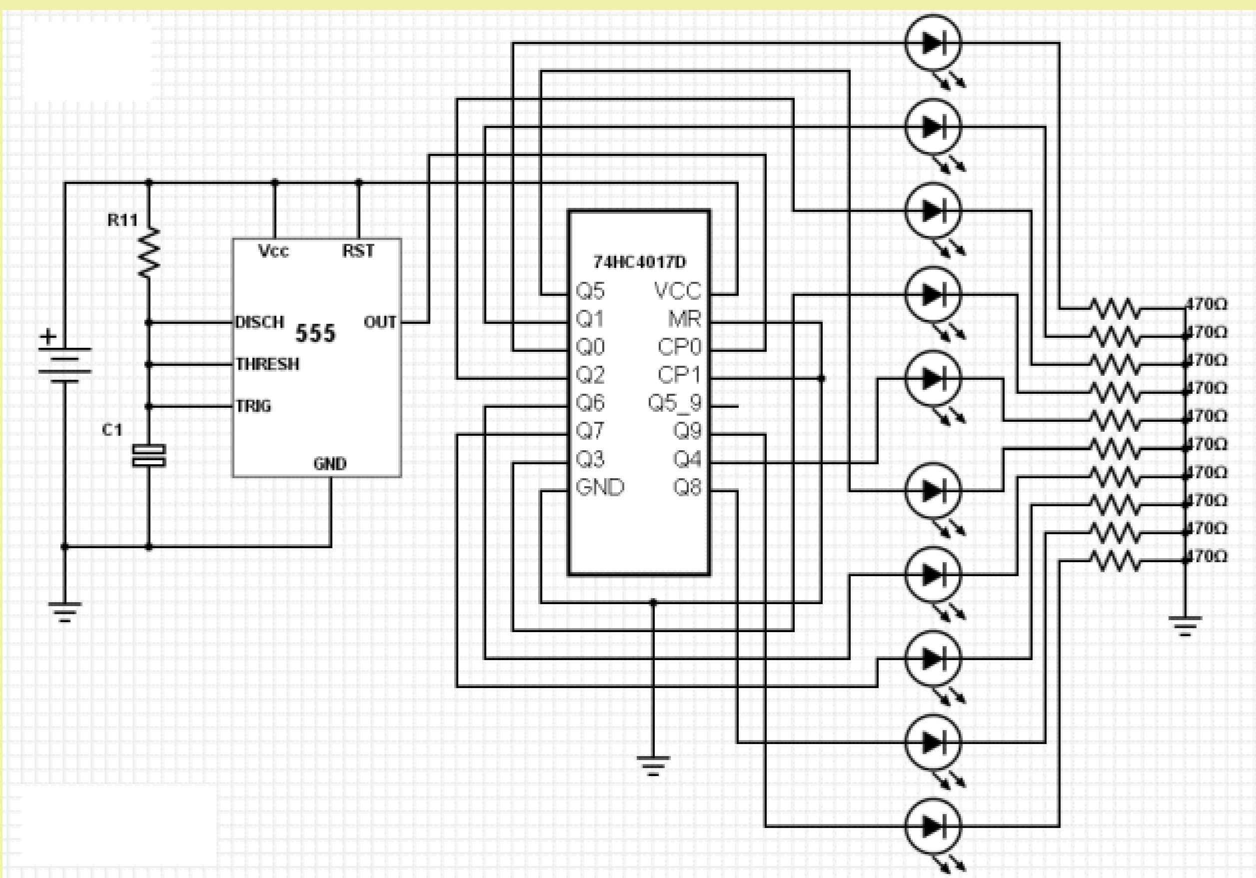


Fig. 1: Remote control extender's circuit diagram

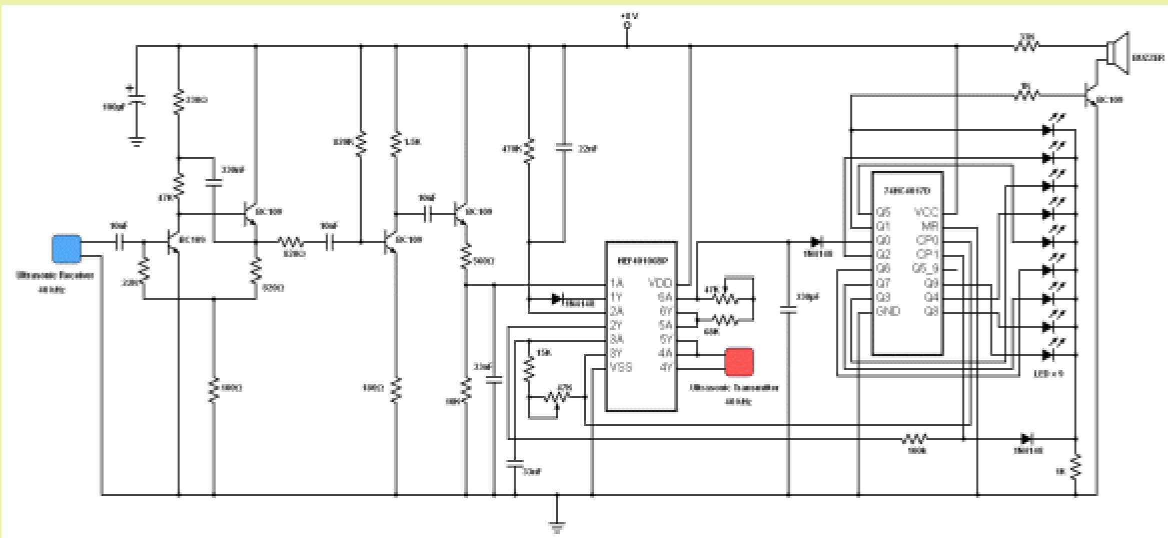
This is one point that has never been mentioned before.
You cannot put 100mA through a mini trim-pot. When the pot is turned fully clockwise, the resistance is very low and about 100mA will flow to the two IR LEDs. The contact of the wiper on the track will not reliably pass 100mA. It will burn a spot on the track and go open-circuit.
This is a point worth remembering.
The solution is to just use the 56R or decide on what level of current you need and use a fixed resistor.
Most IR controllers work to 10 metres. How far from the TV are you?
This circuit just needs 2 transistors and few components - not an op-amp, but that's another story.



You only need 1 x 470R as only one output is high at a time.
A very poor design. No pin numbers, no component values and no understanding of how to lay-out a circuit.
A circuit is NOT a diagram to correspond with pin numbering.

It is a diagram with the least number of "jumpers" - to make the circuit as easy as possible to understand.
People without this understanding should not be presenting circuits on the web.
You should be able to see the output of the 555 connects to the clock-input of the 4017 and each output of the 4017 goes incrementally to the set of LEDs. There should be almost NO lines that cross. That's the skill of presenting a simple circuit. The layout is just a JUMBLE.

This circuit could be very clever or a complete waste of time. But looking at the design, the 4017 outputs Q0 when turned ON and thus the 1k current-limit resistor on the output LEDs has no voltage across it and the voltage divider into the clock of the chip is 1k:100k and thus the clock-line will not go HIGH and the 4017 will not clock.
This circuit is just a MESS and you should NEVER draw chips a block but rather as gates and the 4017 should just have all the outputs on one side to make it easy to see what is happening.
Also, the circuit is too large to fit on the screen and this makes it very difficult to see the whole circuit. Here is the circuit. Click on the circuit for FULL SIZE.



Click for FULL SIZE

How much volume will you get out of a BUZZER with 33k in series ????
It only needs one or two mistakes and a circuit will NOT work. The author is not locatable to solve these problems so I suggest the circuit should be avoided.
It is debatable if 4 transistors are needed on the front-end. The fourth transistor is just an emitter-follower and this type of stage is needed when the output needs to drive into a low-impedance load. The input of a chip is very high impedance this stage can be removed.
There may be a lot of other unnecessary components but until you draw the chip as a set of gates, it is impossible to work out what is happening.
That's why I say the author of this circuit has absolutely no comprehension of electronics.
The whole idea of electronics is to make a complex circuit "look simple."
That's how you get others to understands it.
That's the skill of presenting a project.
That's why I don't use any complex terminology. It only steers reader away.
So many text books turn a simple design into a Boolean Expression - it's no-wonder they lose their readers with frustration.
The same with the circuit above. If it is simplified and drawn to fit the page, the reader can see what is happening. At the moment, even **I** cannot see what the output will produce. A circuit has to tell you all these things without having to refer to the text.

QUIZ MASTER

Here's another over-designed circuit from **ELECTRONICS FOR YOU** July 2014:

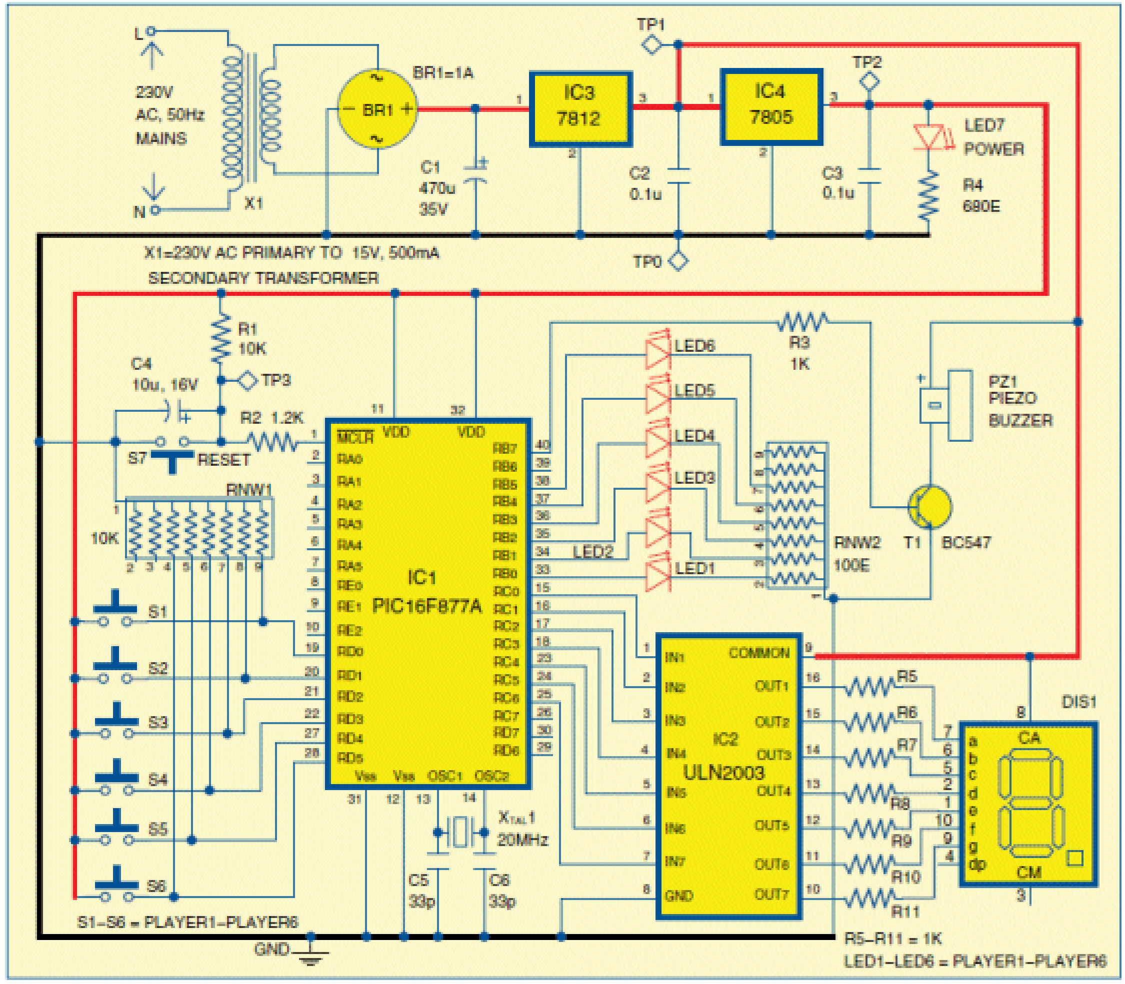


Fig. 2: Circuit diagram of the quiz controller

The output of the microcontroller goes to a row of LEDs and 100R resistors. The current will be over 32mA for a chip that has a maximum of 25mA per drive-line.
What is the point of including the ULN2003 chip when the current for each segment is about 10mA? The chip is capable of supplying up to 25mA per segment.
Why use a crystal? Who needs accurate timing?
The 7812 regulator is not needed.
The transformer should be 0-9v and the power LED with 680R will be very dull.
Just a badly designed circuit form **Dr D.K. Kaushik and Ashok Sharma** who know very little about circuit-designing. Dr D.K. Kaushik is principal and Ashok Sharma is technical assistant at Manohar Memorial (P.G.) College, Fatehabad (Haryana).

Here is another FAILURE from **ELECTRONICS FOR YOU** July 2014:

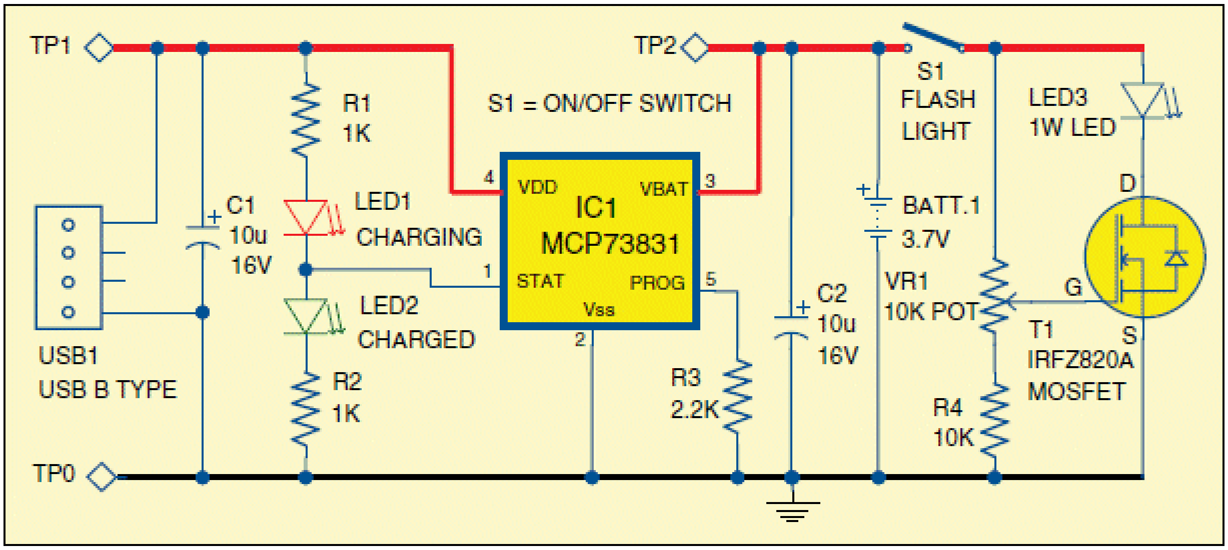
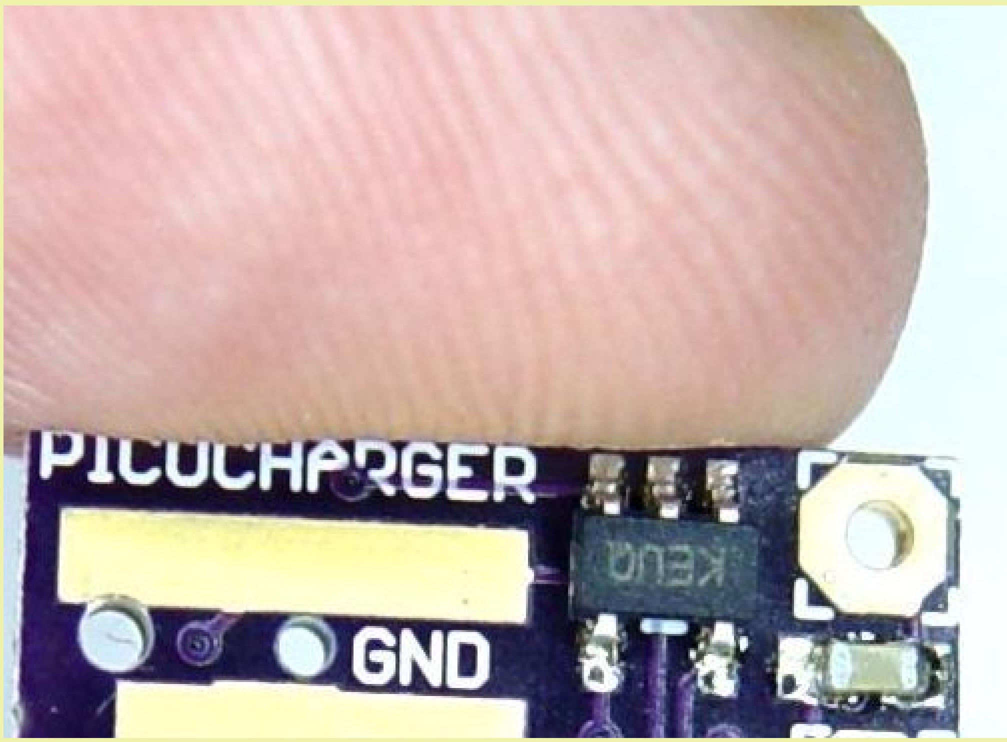
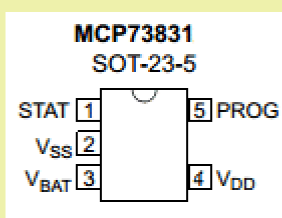
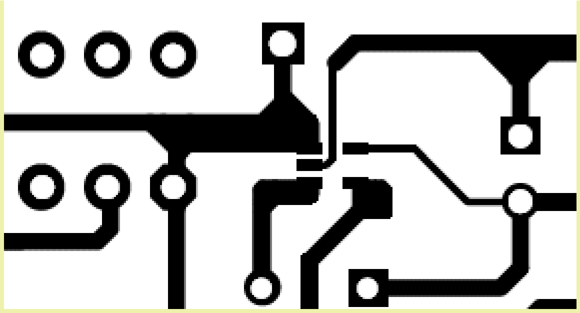


Fig. 2: Circuit diagram of USB LED flashlight cum battery charger

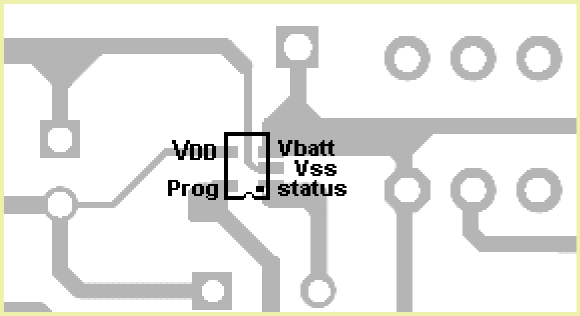




Only the MCP73831 has totem-pole FETs on the STATUS pin to drive LED1 and LED2.



Here is the trackwork around the BATTERY MANAGEMENT CHIP



When the board is turned over, the chip is soldered as shown above.

There is no such MOSFET as IRFZ820A. It is IRF820A. But when you look at the specifications, it is the wrong MOSFET to use.
The minimum ON resistance between Drain and Source is **one ohm**. If the current through the LED is 300mA, the voltage drop will be 300mV. The battery is 3,700mV (3.7v) and a white LED has a characteristic voltage drop across it of 3.6v.
The LED will not take its full rated current and the MOSFET is not required.
The MOSFET should be something like IRF20 with an on-resistance of less than 0.1 ohm.
It's just another UNTRIED project from someone who does not know sufficient about electronics to put a project into an electronics magazine.
You can buy the chip for 80 cents at an electronics supplier (plus $10.00 shipping) or up to 20 chips on eBay for $4.00 including shipping !! That's why you cannot beat eBay !!

Here is another circuit from **ELECTRONICS FOR YOU** July 2014, with mistakes:

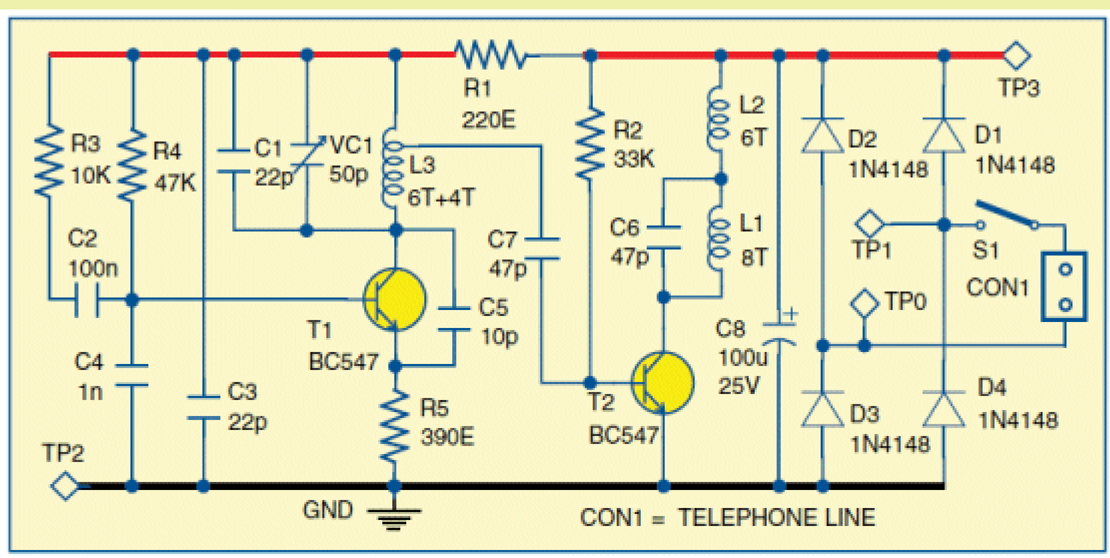


Fig. 1: The telephone tapping circuit

This is a copy of my circuit, which I designed over 20 years ago.
I can see some of the features I designed that are different to any other circuit.
But the circuit has two major faults. The 22p should be 22n and the inductor L2 has no effect as the main amplitude of the signal appears at the collector of the output transistor and the inductor is designed to keep the

output tank circuit (L1 and C6) from the power rail to produce a very high output. In the circuit above, the inductor is simply **reducing** the output to the line.
Obviously the author has absolutely no idea what he is designing and it's just a "Copy and Show" project.
The other major fault is connecting the project **across** (parallel to) the telephone line.
Although the line is about 8v to 15v when the handset is lifted, this voltage will be pulled down even further when the circuit is connected in parallel.
The "bug" should be connected in **SERIES** as the phone line has enough voltage (50v supply) to allow the phone and bug to be connected in series.
The voltage and current of a phone line is complex, because the 50v supply is classified as a HIGH IMPEDANCE SOURCE.
In other words it is a 50v supply with a low-current capability.
The 50v supply has a relay at the exchange with a coil resistance of 1k. It is a special type of relay called a **slugged relay.** It is activated quickly but does not release quickly. This allows the line to be "held" when the decadic pulses are sent down the line. This is the "old type" of dialing with the "turn-the-dial" or "rotary dialler" that opened the line ten times per second to dial the phone number.
This relay does two things. It limits the current to 50mA and activates when the current is more than 10mA.
Another relay (called a step-by-step) detects these pulses and produces a result of the first two numbers. In other words it selects a line after a choice of one hundred possibilities.
This is all old technology but the exchange still delivers the same impedance to your phone and the short-circuit current is up to 50mA and the operating current is about 20mA - 30mA.
Putting the "bug" in parallel is an absolute disaster.
It " hogs the line" and does not allow the phone to "hang-up."
Unless you have studied the phone line and studied FM circuits, you are making a FOOL or yourself, when presenting a project.
The author has absolutely no idea about series and parallel connection on a complex set-up such as a phone line and no idea what he is doing with FM transmitters.

Here is another circuit from **ELECTRONICS FOR YOU** July 2014:

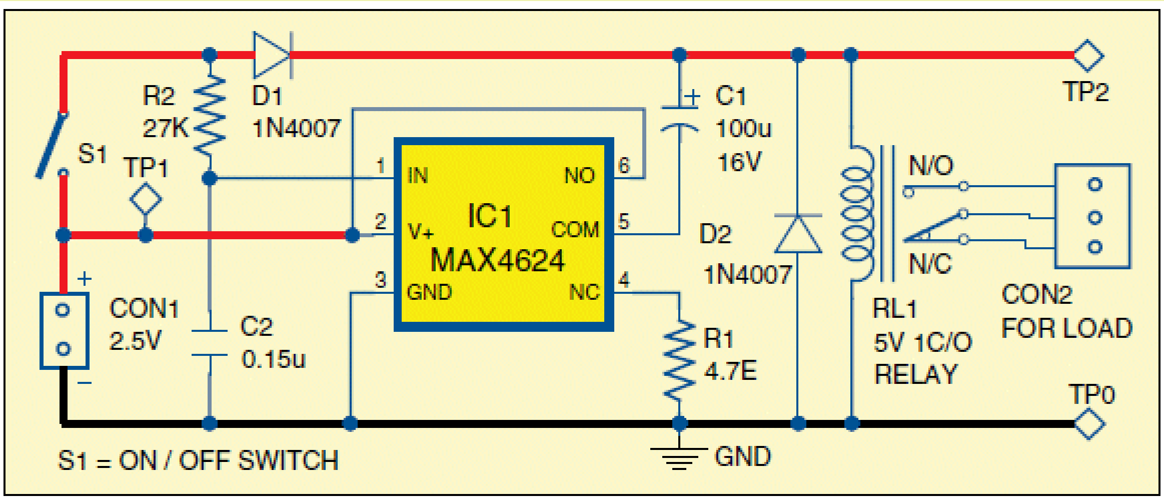


Fig. 1: Circuit diagram of the efficient 5V relay driver

The circuit drives a 5v relay from 2.5v.
Where can you get a 2.5v supply ?????
Instead of messing around with a complex circuit, you can get a 1.2v solid state relay for $4.00.
The relay requires about 20mA to "turn ON" so you will need a resistor in series with the input pin to limit the current to 20mA. The two input pins are marked positive and 0v because they connect DIRECTLY to a LED. The input current illuminates the LED and activates a light-detecting TRIAC. The characteristic voltage-drop across the LED is between 1.2v and when the current reaches 50mA, the voltage-drop is 1.4v. This means you MUST include a current-limiting resistor to limit the current to between 20mA and 50mA. The relay will turn on at 8mA, but you should test it before using this low value. This will allow you to use a supply voltage form 1.2v to 5v or more.
The MAX4624 is a 16-pin surface mount chip.
The max4625 is 8-pin surface mount and costs $4.60 plus postage.
Just another disastrous circuit from EFY.

To Sani Theo,
Technical Editor,
Electronics For You

Yes, of course I am annoyed.

All the Australian and English magazines publish any corrections and mistakes to circuits BUT you fail to inform your readers of the DISASTROUS mistakes.

You don't even have the intelligence to pass the mistakes to the authors of these articles and get a response.

Thank goodness you have stopped Professor Mohan Kumar supplying projects.

His projects were riddled with mistakes and I have finally got him banned from supplying articles to electronics forums.

You have got to improve your editing of projects and get an EXPERT to analyse them before publication.
I have monitored the building of the projects in EFY for the past 12 months and found the construction to be virtually ZERO.
Everyone I contacted found the projects DO NOT WORK.
And it is NO WONDER.

Who do you think you are trying to FOOL ??

No-one in the Western world takes any of the projects seriously and this is borne out by the fact that so few subscribe to the magazine.

Unless you improve the quality of the simple projects, you will NEVER get any respect.

I have not even bothered to look at the more-complex projects because they mostly involve a microcontroller I do not purchase.
But if the simple projects are not constructed, I suspect the more advanced projects are avoided too.

Your Kit-N-Spares section is also a disaster with projects lacking an overlay and hand-written scribble on the PC board.
Just take a look at the boards and see what an insult they represent to the electronics world.
Lastly, look at the postage. You want $50 USD to post a $5.00 kit ?? China posts things for FREE !!
You (India) say(s) you want to present as an advancing technical (technological) market and have all the technical expertise to take-on world-wide challenges and yet the technical contributors to the magazine show little aptitude to quality designs and no-one has challenged the faulty circuits.
You are fooling yourself with the technical expertise in the country and failing to deliver a quality product to the electronics experimenter.

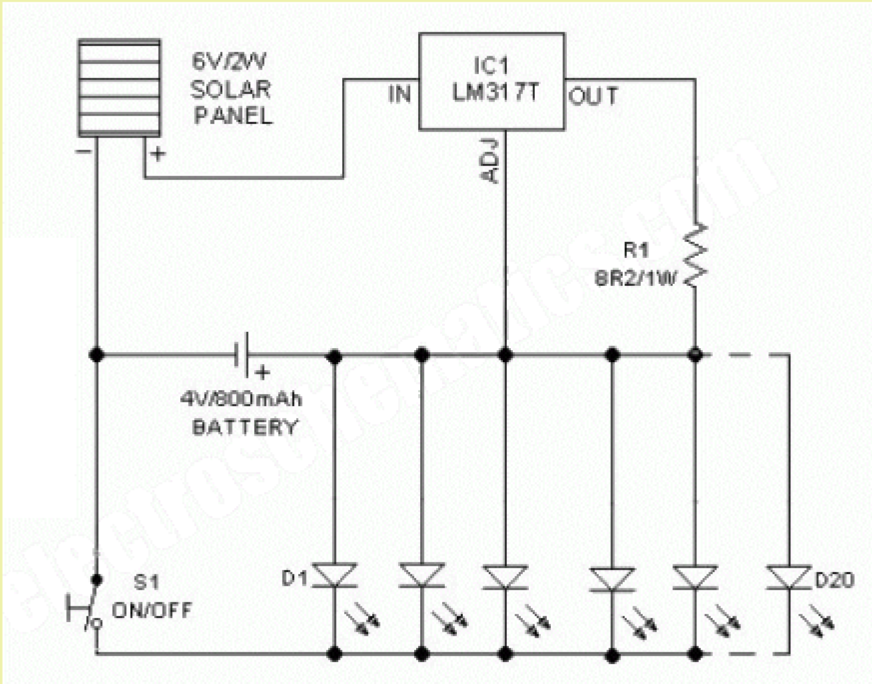
I am trying to protect the uninitiated beginner who looks at your faulty design s and thinks they are the correct way to design a circuit.
I get hundreds of emails from Indian readers who visit my site and ask for guidance. They are stagnated by the terrible lack of technical material emanating from Indian publishing houses.
It is fortunate the internet is correcting this.

I have been sending you emails for the past 12 months on these subjects and you have not replied. You have not updated the circuit boards, **ANY** of the projects (nothing has been added for the past 12 months) and you have not changed any of the images. Neither have you looked into postage costs for the kits.

What more can I say ???

Colin Mitchell
TALKING ELECTRONICS

This project has been on the web for 3 years and no-one has realised it DOES NOT WORK:

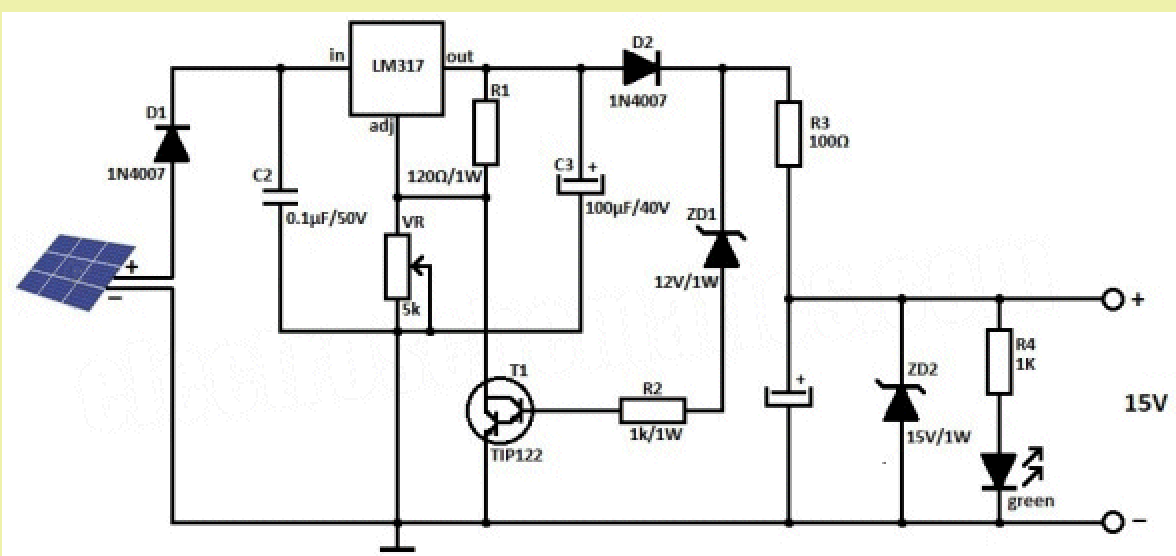


The LEDs are exactly like a 3.6v zener across the battery. They will take a lot of current if a current-limiting resistor is not included.

Problem number two:
The 6v solar panel needs to develop 5.5v to overcome the back-voltage developed by the battery when charging. The LM317T needs 1.5v across it and if the charging current is 100mA, the 8R2 develops 820mV across it. This is a total of 7.8v. The 6v panel will not develop 7.8v.

The LM317 is in constant-current mode and will limit the current to 140mA but at 100mA the solar panel cannot produce enough voltage to provide any charging current. The whole circuit is a MESS.

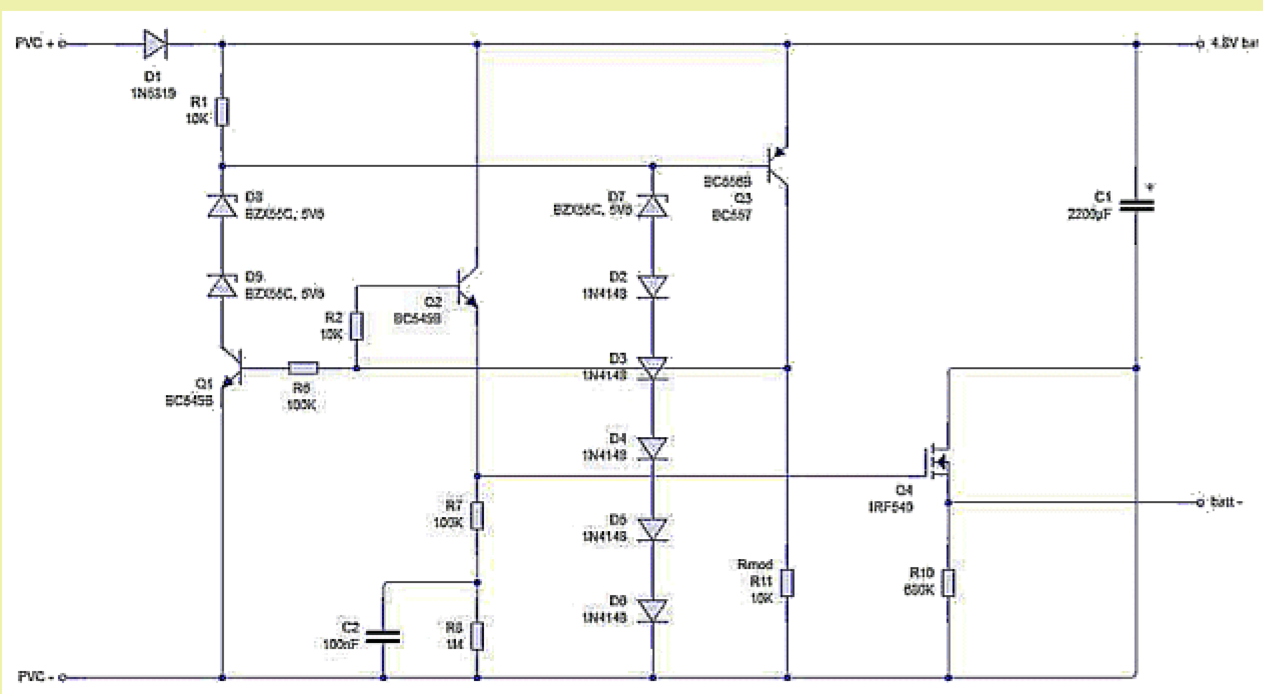
SOLAR CHARGER
This is another complete MESS from D Mohankumar.



The solar panel is 24v.
The 12v zener will limit the output voltage to 12v + 1.2v =13.2v How can you charge a 12.6v battery with 13.2v ??
Another untried, untested non-working circuit from **PROFESSOR** Mohan Kumar.

Battery Charger

This is one of the worst battery charger circuits I have seen.
To start with, the PNP transistor, 5v6 and string of diodes puts a zener voltage of 0.6 + 5v6 + 3v on the supply rail and if the battery is removed and the supply rises above 9.2v the transistor will be DESTROYED !!
The whole circuit is equal to a current-limiting resistor of unknown value and the circuit will effectively deliver all the current from the solar panel to the battery.
If the solar panel can deliver 20 amps, this current will flow into the battery and BLOW IT UP.
Let's see what the circuit does:
As soon as the supply reaches 9.2v, the PNP transistor turns ON and this turns ON the emitter-follower transistor Q2 and raises the gate voltage on the MOSFET.
The supply only has to rise a few more millivolts and the PNP transistor is fully turned ON and the MOSFET will be fully turned ON. So the difference between the MOSFET being not-turned-ON and fully turned ON is only a few millivolts change in the voltage on the supply rail.
Now let's look at the MOSFET.
When (if) it turns on fully, the battery is connected directly to the solar panel and the supply rail is 4.8v plus the "floating voltage" produced by the battery when it is charging.
This means the battery voltage can be as high at 5.5v.
This is not high enough to get the circuit to turn on, so the MOSFET allows the difference between 5.5v and 9.2v to be dropped across it.
This is purely a VOLTAGE DROP and you can consider the voltage drop to be identical to a zener and the MOSFET will not limit the current.
We do not know the voltage of the solar panel or its current capability and this will be the limiting factor of the circuit.
But as soon as you remove the battery, the transistor will blow up.
The first transistor only starts to come into operation when the supply reaches 5v6 + 5v5 + 0.2 + 0.6v = 12v and it is clear that the supply can NEVER go above 9.2v without blowing up the circuit.
Thus the whole circuit can be replaced with a current limiting resistor and the battery will not be destroyed.



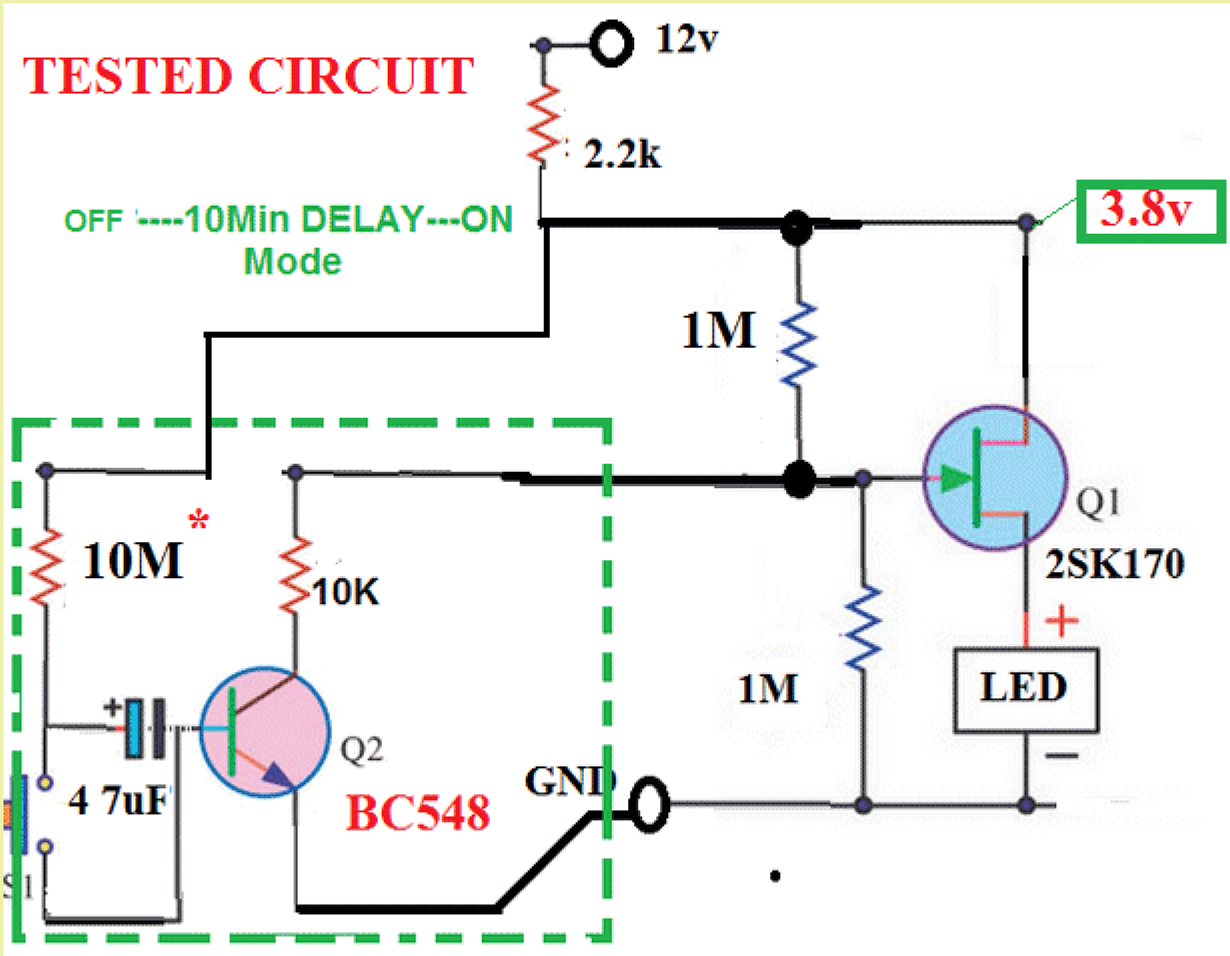
ANOTHER DISASTROUS CIRCUIT

Thanks for these articles on: "So-called experts with all the fancy degrees!"

I'm 72 years of age. I've met so many of them in my working lifetime, they were the bane of my life!

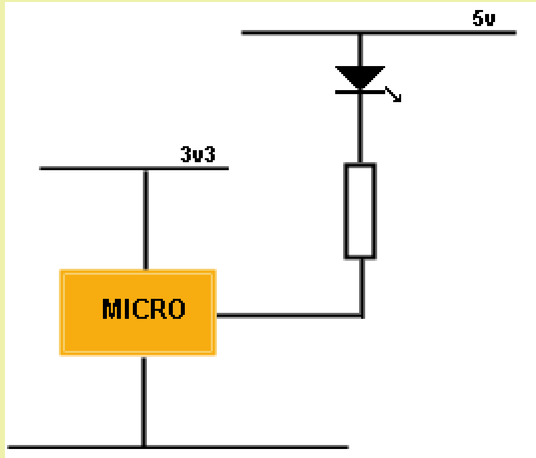
KEN

10 MINUTE TIMER



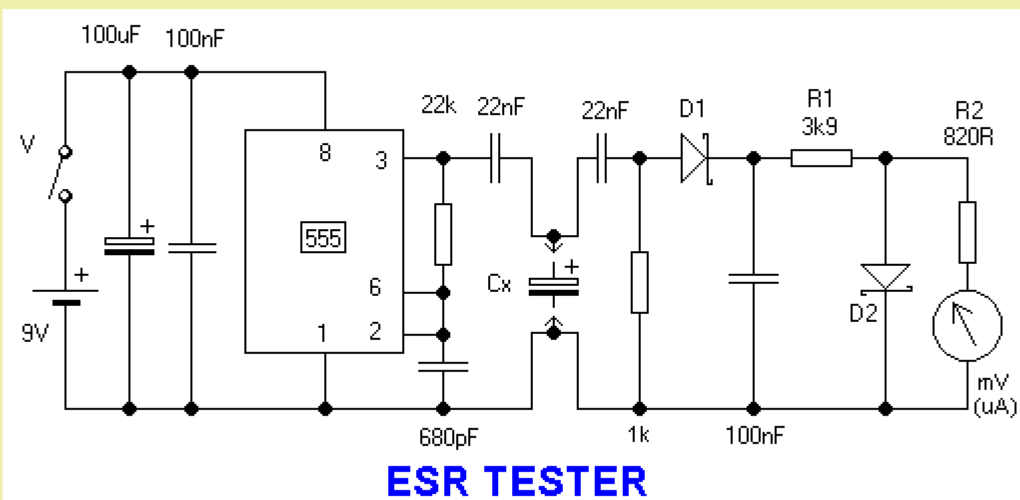
The problem with this circuit is the 10M resistor.
It is only allowing 1 microamp to flow into the base of the transistor and this is causing two problems.
1 microamp is not enough to maintain the polarisation of the electrolytic and it will lose its capacity over a period of time.
Because the electrolytic is not maintaining it polarisation, it will become leaky and the leakage current will cause 1 microamp to flow AT ALL TIMES and the circuit will never turn off.
In fact the transistor is making the circuit between 100 and 300 times WORSE by requiring the 47u to be charged via a 10M resistor.
Without the transistor, the electrolytic could be charged via a 470k to 1M and the timing would be 10 times more reliable.
The circuit has a SCHMITT TRIGGER action.
The uncharged capacitor turns on the transistor and the gate voltage is LOW. The MOSFET is not turned on.
As the 47u charges, the base current falls and the transistor begins to turn OFF. The gate voltage rises and and the MOSFET begins to turn ON. This reduces the effective "turn-ON" voltage on the gate and the transistor continues to all the gate voltage to rise. The MOSFET now starts to draw current and the voltage on the top of the MOSFET starts to drop and this reduces the current through the 10M resistor. This turns the transistor off slightly and the voltage on the gate rises at a faster rate.
This action circulates around the two components and very soon we have a condition where the transistor is fully turned OFF and the MOSFET is fully turned ON.
This action has not been due to the electrolytic gradually charging but the voltage on the top of the 10M reducing from 12v to about 4v.
This action may over-ride the poor design with the 10M and by using a tantalum or low-leakage electrolytic, the circuit may function.
However, the point still exists, not to use a 10M resistor to charge an electrolytic.

Here we have the case of a 3v3 microcontroller turning on a LED that is connected to a 5v rail.



Many responders on a forum said this cannot be done and should not be done. Others said it will damage the microcontroller and other absurdities.
The fact is this: It is quite acceptable to control the LED as shown. The LED will have a characteristic voltage of about 1.7v to 3.6v across it before any current flows and this means the voltage across it when the 5v rail is delivering 5v and the output of the microcontroller is about 3.2v, will be 1.8v. A red red will begin to turn ON and so a green or orange LED can be used. A white LED will be ideal.
The LED will indicate two things at the same time. When it is illuminated, it will indicate 5v rail is alive and the 3v3 microcontroller is operating.

ESR TESTER



Here is a simple circuit to test if a capacitor has "dried out" or lost some of its ability to deliver a high current.
ESR means Equivalent Series Resistance and most capacitors appear with a Equivalent Series Resistance of a a fraction of an ohm or a few milliohm.
In general, this value is not important and you simply compare the old electro with a new electro and see if the reading is the same.
The circuit is a very good design and works well.
It was placed on an electronics forum and two moderators/responders, Chuckey and Audioguru (with thousands of postings), gave this reply:

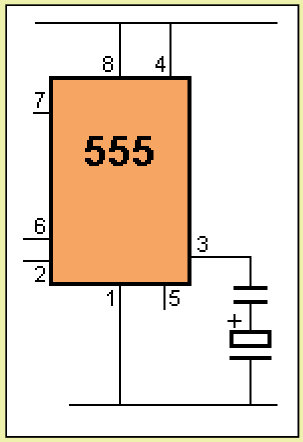
The 555 oscillator is feeding positive and negative AC to the capacitor being tested. Reverse polarity is bad for a polarized capacitor.

I replied:
Who said the capacitor is seeing a "reverse voltage" across its terminals?

The 555 has a 22n series output capacitor that has an output to the capacitor under test

that swings positive THEN NEGATIVE then positive THEN NEGATIVE again over and over. So the capacitor under test gets reverse polarity half the time unless its value is MUCH higher than 22n.

This is RUBBISH. It is amazing how a person who has been in electronics for over 30 years and replied to more than 34,000 enquiries can make such a false statement.
The problem is he cannot "see" how the circuit works.
The energy supplied to the electrolytic during the charging cycle will be removed during the discharge cycle and thus the positive lead of the electrolytic will simply increase to a small voltage and decrease to ZERO.
Here is an animation of what is happening:



Can you see any "negative" voltage entering the electro????

If you cannot see a circuit working, you have no possibility of testing, designing and repairing it.
Simply connect the circuit your are investigating to a CRO and reduce the timing to a low frequency and see what is happening - BEFORE making a stupid statement on a website.
One of the amazing features of a capacitor is this: It will convert a low-current high-voltage into a high-current low-voltage. That is exactly what is happening here.
The result of a low-current high-voltage is called ENERGY and it requires a lot of current to increase the voltage on the electro for each volt produced on the leads.
That's why the small capacitor produces a high voltage across it during the charging cycle.
The two responders are getting mixed up with a circuit consisting of a capacitor in series with a resistor. Or a capacitor in series with a diode. When the output of the 555 goes LOW with these two components connected, the voltage on the lead of the capacitor DOES fall below the 0v rail.
But that's why you have to LEARN ELECTRONICS.
You cannot afford to make a mistake like this and broadcast your ignorance to everyone else.
This is only one of many mistakes made by the posters and that's why I have decided to monitor the forums and correct their glaring mistakes.
The most disturbing part is their inability to realise their mistake after reading my corrections. Hopefully others will learn.

BATTERY VOLTAGE

Here's another mistake from Audioguru

"A 12V lead-acid battery that measures 12.5V with no load is almost dead."

This is totally FALSE.
A 12v lead acid battery should read 12.6v after it has been charged.
During the charging process it will generate a "floating charge" or "floating voltage" up to 15v due to the resistance of the bubbles of gas and also the type of material used in the plates. This voltage is the reason why they call some batteries "maintenance free" or "sealed" because they do not produce gas bubbles until a high voltage is developed across each cell. If you keep the charging voltage below this voltage, the battery will not produce gas and can be sealed.
You cannot measure the battery voltage immediately after charging due to the "floating voltage" it shows on a voltmeter. You need to wait 10 minutes and then apply a load for a short time to settle the activity within the cells.

BLINKING LED

Here's an example of how NOT to draw a circuit:

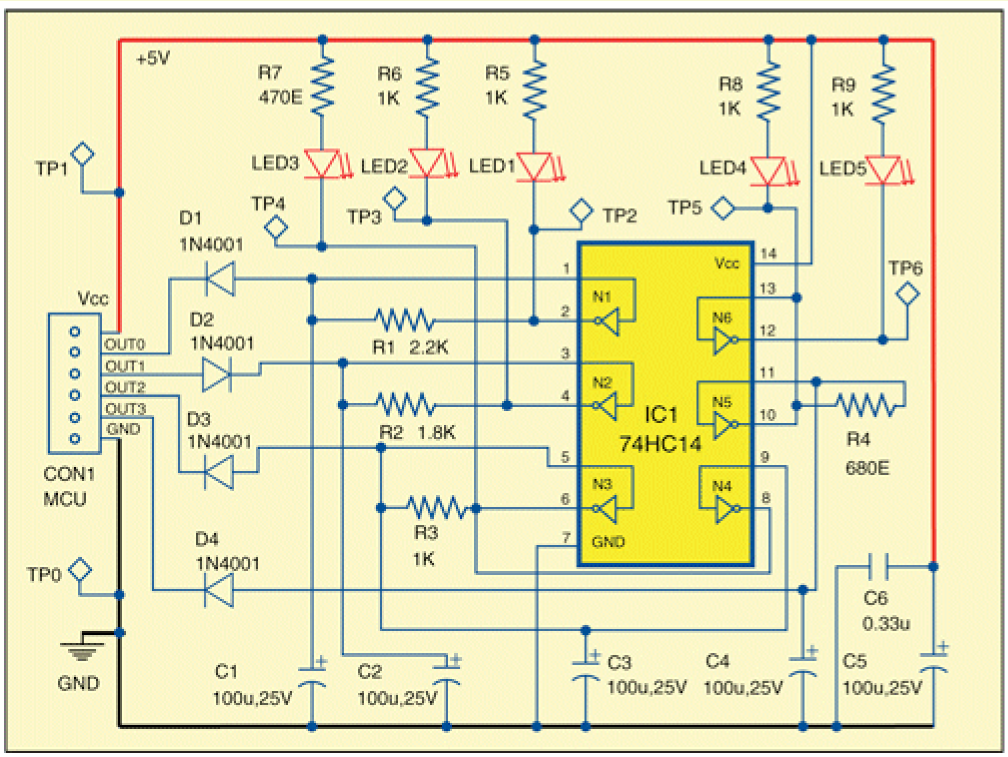
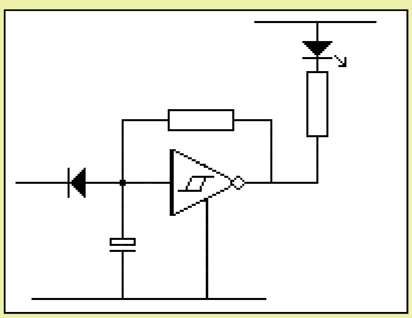


Fig. 1: Circuit for efficient LED blinking for embedded systems

The circuit may work but it is impossible to see how it is working. Do do not know if the blinking is coming from the inputs or if it is generated by the components. The gates are SCHMITT TRIGGERS and this symbol is missing from the diagram.

The basic oscillator is shown in the diagram below.



The whole diagram should show the 6 oscillator circuits so you can see if it is gates with a low signal or a HIGH signal and see what is happening with ALL the gates. I have absolutely NO IDEA how some of the gates are connected and a properly laid out circuit diagram will provide these details.
This is important if you want to modify the circuit or locate a fault when the circuit does not work.
The diagram above is absolutely USELESS. It is just a JUMBLE. It is partially a layout diagram showing where the components are placed or how they are connected to the chip.
That's NOT the purpose of a circuit diagram.
It is entirely designed to show HOW THE CIRCUIT WORKS.

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556 How do deal with a 556 circuit

It's hard enough to work out the operation of a 555 circuit. It's IMPOSSIBLE to work out a 556 circuit.

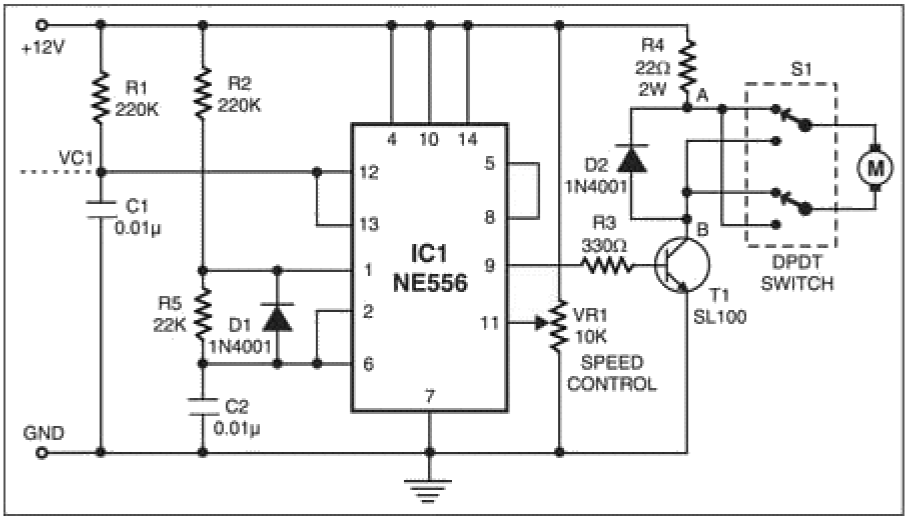
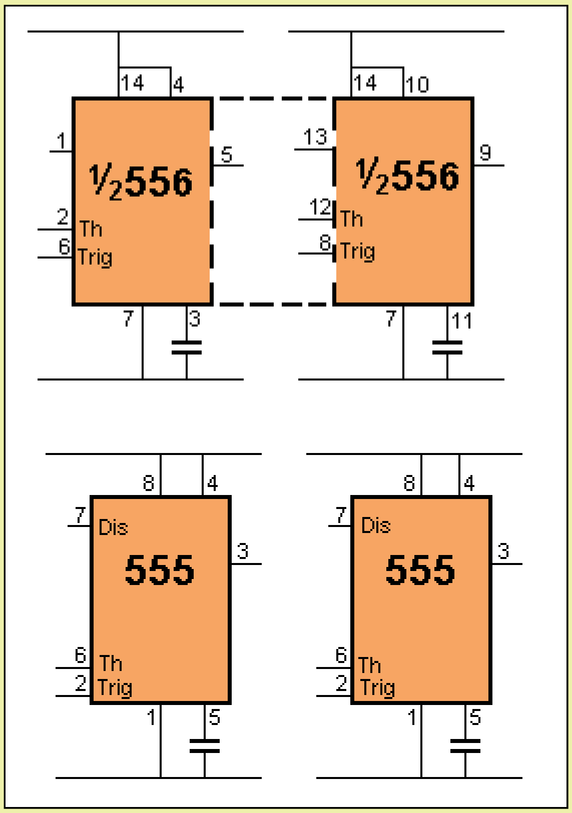
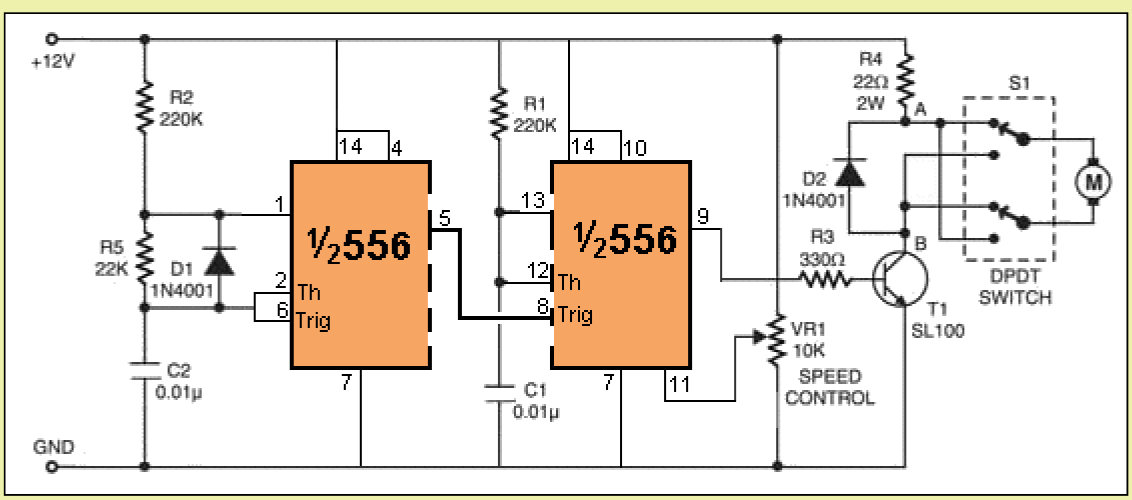


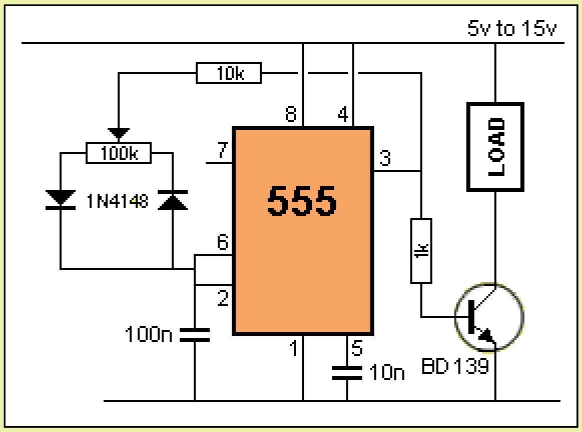
Fig. 2: The circuit of PWM-based speed controller

Rather than wasting time learning about the 556 chip, it is much easier to explode the 556 into two 555 circuits:



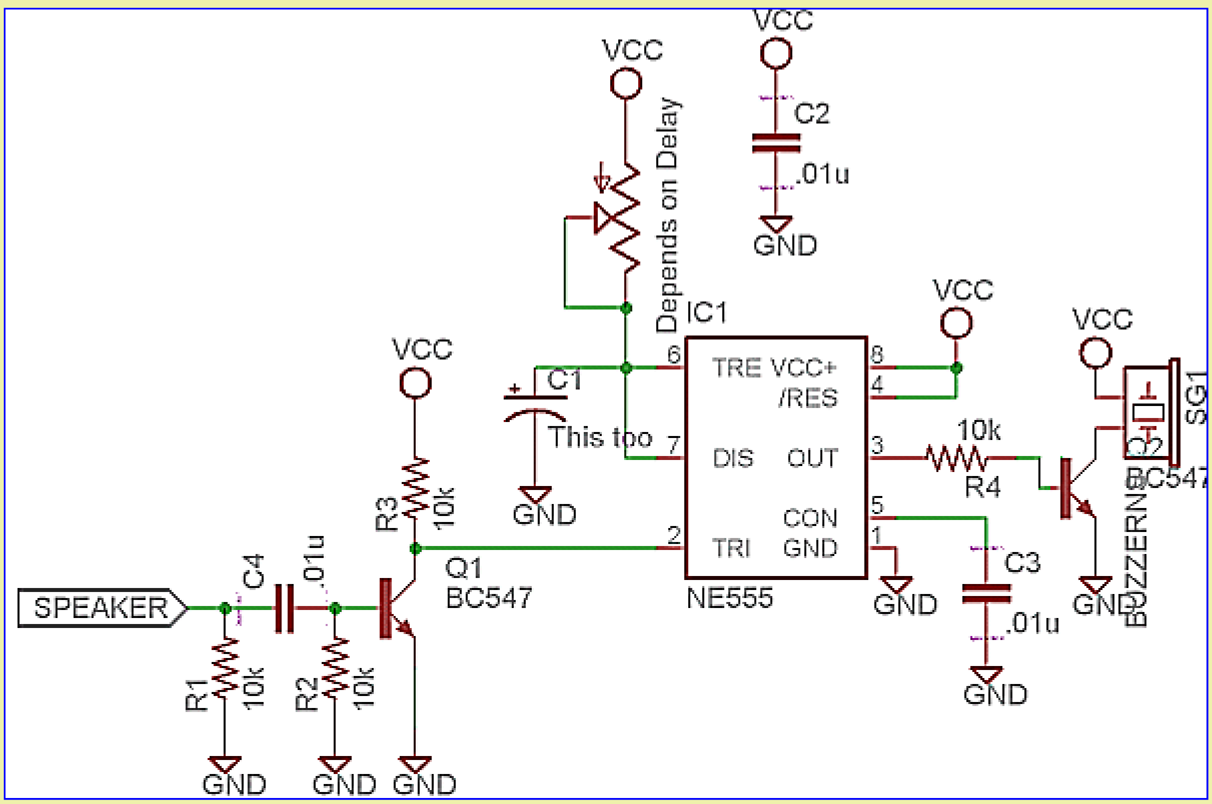


The circuit is now easy to see. All the connections are in the same places as when using a 555. Do not be confused with pins 2 and 6 on a 556. The lower pin (on the circuit) detects the LOW voltage and the upper pin detects the HIGH voltage. The numbers of these pins are swapped when using a 555 / 556 and this is very confusing.
What is the purpose of complicating things with a dual 555 when a simple 555 will provide the required mark-space ratio. There is NO SKILL in making a complex circuit, where a simple design has already been produced.



PWM USING A 555

SPEAKER TO 555



Here is a typical circuit posted on a forum. It simply DOES NOT WORK.
The circuit is supposed to detect the sound from a speaker to trigger a 555.
The output from a speaker is typically 20mV and may rise to 100mV when detecting a loud sound. The BC547 needs at least 650mV
Resistor R1 is not needed.
The pot will be damaged with turned to zero ohms and pin 7 goes LOW.
It's circuits like these that give the web a BAD NAME.
They are untried, untested and show the designer has absolutely no idea of electronics.

COOLING FAN

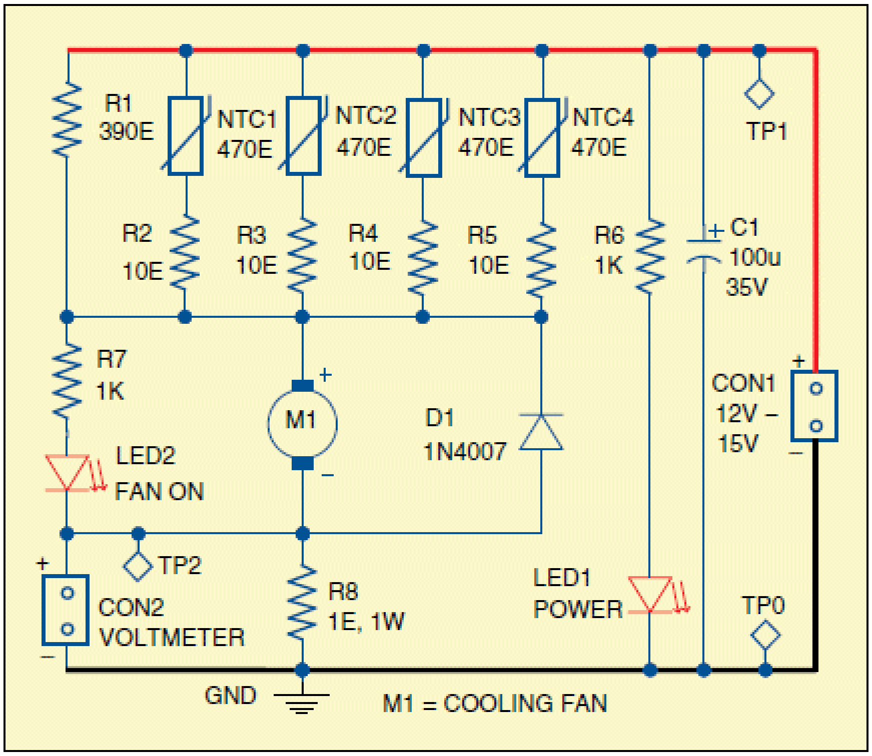


Fig. 1: Circuit diagram of the speed controller

The circuit drives a cooling fan (12v 1.2w) and the negative temperature resistors are placed on hot items. These reduce in resistance when the items get hot and the fan increases in speed.
The fan takes 100mA when connected to the 12v supply.
The whole circuit is overdesigned and quite unnecessary, but lets look at the absurd design.
Firstly, what is the function of R8? The text says the voltage across this resistor will be up to 1.35v but when 100mA flows, the maximum voltage will be 100mV. !!! Why specify 1watt resistor ???
What is the function of the 10 ohm resistors?
The resistance (or impedance) of the fan is about 120 ohms.
The NTC resistors will drop to 42 ohms when all are detecting 100°C. This makes the whole resistor network equal to about 10 ohms.
If you remove the 10 ohm resistors, the NTC resistors only have to detect an additional 10°C to achieve the same overall resistance. Or you can use 330R NTC resistors.
What is the function of diode D1 ?? What is it protecting ?
What is the function of LED2?? The fan will always be operating.

40kHz TRANSMITTER

When a door opens, the transmitter sends a 40kHz signal to a receiver.
The circuit is over-designed and takes about 10mA when sitting around doing nothing. This is a waste of current the circuit needs a power supply.

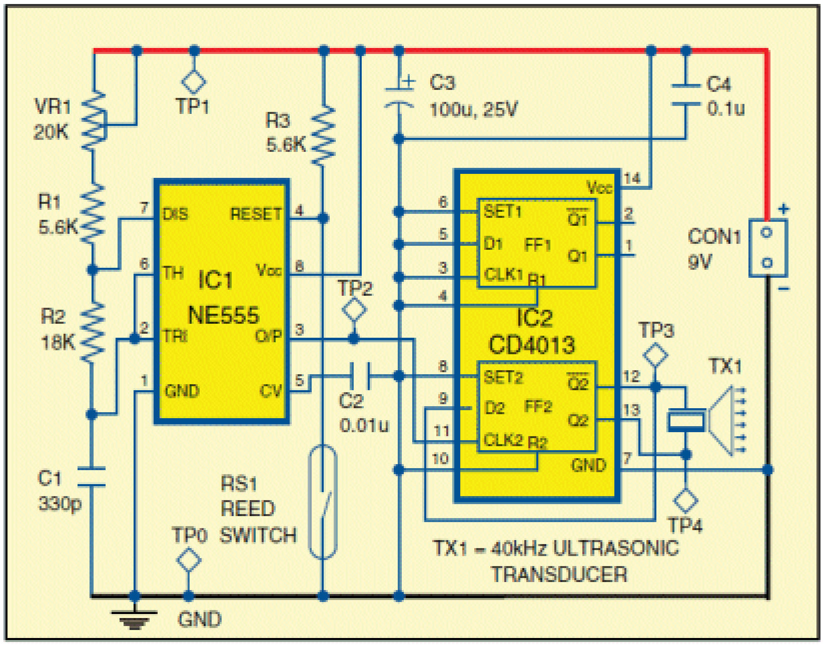
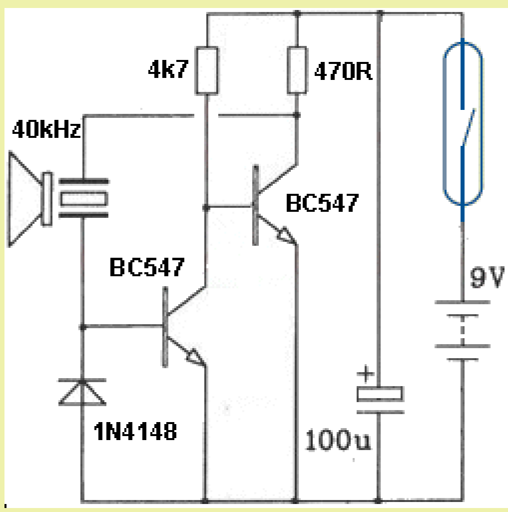


Fig. 1: Circuit diagram of the transmitter

The circuit can be simplified to:



There is NO SKILL in designing a complex circuit when a simple design has already been provided on the web. The transistor circuit finds the natural frequency of the transducer because it contains a crystal that resonates at 40kHz. This saves providing any timing components and produces the highest amplitude due to resonance and the frequency is exactly 40kHz. This is the simplest and best design.

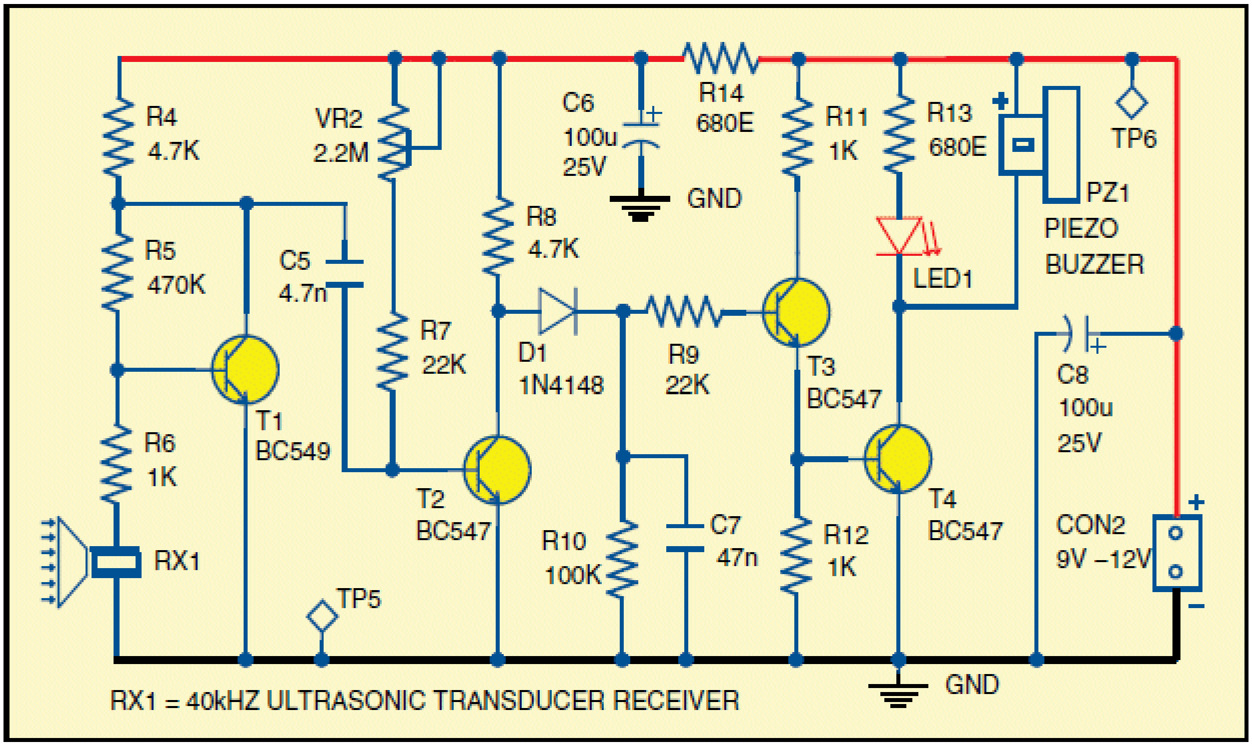


Fig. 2: Circuit diagram of the receiver

This circuit above is poorly designed and has a number of fundamental faults.
It will be very difficult to turn ON the second transistor to the point where the collector voltage is below 1.8v, but higher than about 1v, by adjusting the current into the base.
It needs to sit in this range for the circuit to have the best sensitivity.
If you turn the transistor ON too hard, the circuit will require a lot of energy from the 4n7 to remove this turn-on current and turn the transistor OFF.
Don't forget, the next two transistors rely on current form the 4k7 to produce an output. The transistor does not drive the output, the 4k7 delivers the energy to the diode pump. It is not really a diode pump because it is really pulsed DC and not AC driving the diode pump section.
The capacitor charges when the second transistor is turned OFF or nearly turned OFF.
The slightest change in temperature or supply voltage will alter gain of the second transistor and either turn it ON more to decrease the sensitivity of the circuit or turn it OFF more and cause the circuit to false-trigger.
The next point to note is the sensitivity of the diode pump has been reduced by the inclusion of the third transistor. This transistor is an emitter-follower and does NOT assist in the operation of the circuit. In fact it reduces the sensitivity of the circuit.
The diode pump is perfectly capable of turning ON the output transistor as it only requires only a very small current into the base (less than 0.5mA) and the 4k7 will deliver this current.
The 1k on the base of the output transistor is far too low for a transistor delivering 50mA collector current and should be 10k to 47k.
The 1k on the base of the first transistor has no effect because the 40kHz transducer is a high impedance device so it will not increase the base to ground impedance and the signal out of the transducer is so small that 1k will have no effect.
The 2M2 pot should be 2M as pots are only available in 1M and 2M.
The whole circuit shows a lack of understanding of the principles of sensitivity.
The circuit needs to be very sensitive to detect the very weak 40kHz signal and the stages should be AC coupled to allow for variations in temperature and supply voltage.
The second transistor should be self-biased and AC coupled to the diode pump so no adjustment is needed.
The third transistor can be eliminated as the circuit only needs voltage gain because the output current is only about 50mA.
The third transistor is only providing current gain, which the circuit does not need and if the base resistor of the output transistor is increased to 10k to 47k, we will ncrease the gain of the circuit by 10 times to 47 times.
If the second transistor is AC coupled, ALL of the signal from the 40kHz transducer will be passed to the diode pump.
If the signal on this transistor is 1,500mV, the output will respond if the third transistor is removed.
This requires 30mV into the base.
To get 30mV on the collector of the first transistor the transducer needs to produce less than 1mV. I don't know how this relates to the required sensitivity of the circuit but it represents the maximum sensitivity for the circuit and it is AUTOMATICALLY self-adjusting and AUTOMATICALLY delivering the maximum overall gain without

any need for adjustment.
This is how to work out the requirements of the circuit.
It is a **VOLTAGE REQUIRING** circuit not a **CURRENT REQUIRING** circuit.
And secondly, it is very difficult to DC-control 2 stages. This is because each stage has a gain of about 100 in DC conditions and 100 x 100 = 10,000. The change in current on the base of the second transistor is being multiplied 10,000 times by the time it reaches the LOAD and picking the correct level of **DC BIAS** is very difficult.
The operation of this circuit is much more-complex than you think and you need to read our comprehensive article on designing transistor stages to see how to design stages correctly.
You NEVER try to control the bias on a stage via the base resistor.
This circuit shows 4 areas of bad design and although the "circuit will work" it is obviously not designed by a professional and not a design to be presented to **beginners in electronics**.

POWER SUPPLY

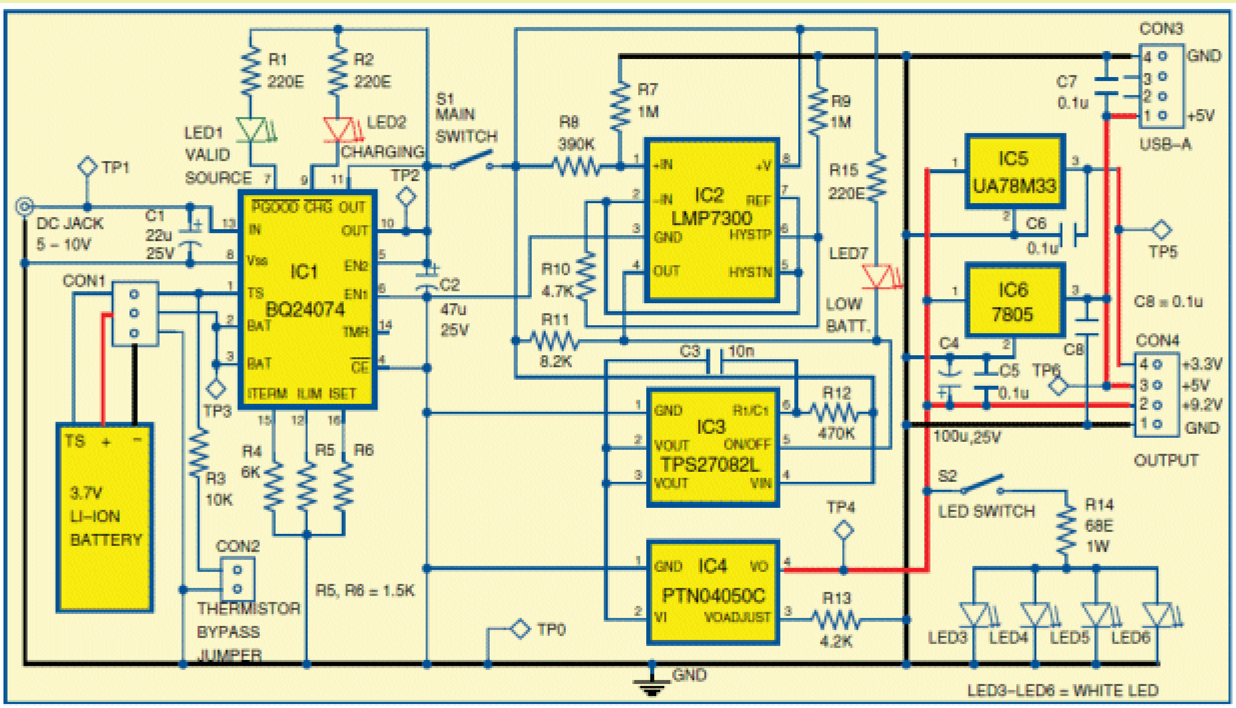


Fig. 3: Circuit diagram of the mini rechargeable power supply

Here is another over-designed project.
Basically it will supply 3v3, 5v and 9v2 from a 3.7v Li-Ion battery.
But let's look at the design in REALISTIC TERMS.
The whole project is just an expensive way to get different voltages from a 3.7v battery.
It uses a PTN04050C boost converter module that takes the 3.7v and converts it to any voltage to 15v. This module costs $16.00 !!
We now take the output of this converter (9v2) to a UA78M33 - a 3.3v linear regulator to deliver 300mA. This process wastes 70% of the energy !!!! We are converting 3.7v to 9.2 and then reducing it to 3.3v ???? The data sheet for this IC does not tell you know the wattage dissipation for the device and this is very deceptive as it will probably only dissipate 1 watt. Using it on a voltage as high as 9.2v @ 300mA will dissipate 1.77 watts.
The 7805 also wastes nearly 50% in delivering its voltage and current. And this waste ends up as heat.
For both regulators, the designer of the circuit has not provided any mention of a heatsink and obviously does not know anything about heatsinking a device.
Lets look at the problem.
To work out the maximum current for a 7805 with 9.2v input, the thermal resistance is measured in degree C rise per watt. For a TO220 (7805 and uA78M33) case the max Tj (junction temp) =125 C, and TRjc (thermal resistance-junction to case with no heatsink) = 50 deg C/watt.
Now we can do some calculations:
The author claims the 7805 will deliver 800mA
9.2 volts input voltage, 0.8 amp load, 25 deg C ambient;
9.2 - 5 = 4.2 volts across regulator. 0.8 amps = 3.36 watts dissipation.
Temp rise, junction to ambient = 3.36 x 50 = 168 deg C.
Add ambient temp, Tjunction = 168 + 25 = 193 deg C!
The specification is 125°C max so you need a heat sink.

For the uA78M33 the wattage dissipated is 9.2 - 3.3 = 5.9 x .3 = 1.77 watts and it will get to 115°C.
This is very hot and simply a waste of energy.

This project will cost more than $30.00 (plus shipping charges) for a something that could be achieved with a number of rechargeable cells and two regulators. You can buy a 18650 rechargeable battery on eBay for $1.50 each (post free) and a charger for $2.50 (post free) that will charge 2 cells at a time. Buy 6 cells and you will have 3 cells for the project and 3 cells being charged. These cells are 4,000mAHr and are much larger than the 1200mAHr cell used in the project and will last 4 times longer. By using 3 cells you have a project that will last 12 times longer at less than one quarter the cost.
It's simple ECONOMICS.

VAPORISER

You wonder why electronics magazines don't show photos of the projects. Simple. They do not build the prototype. Here's a typical example. Where is C1 ????

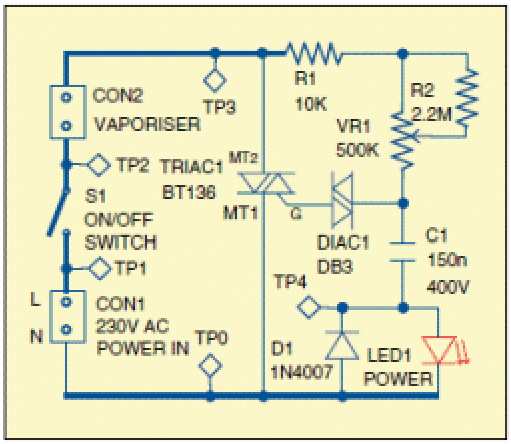


Fig. 2: Perfume vaporiser adaptor circuit

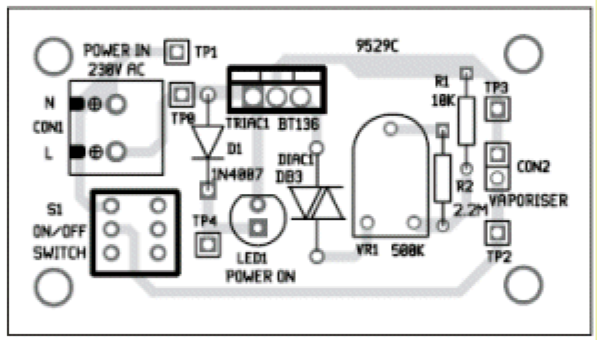


Fig. 4: Component layout for the PCB

Why go to the effort of producing a PCB layout for the magazine and not provide the trackwork for the reader? Why not show a photo of the complete project? Because they NEVER get the board made and never build the project. It all called "CLOUD" designing. It's all illusionary.

I have supplied over 20 major corrections and faults to the circuits in **Electronics For You** and have not received a single reply or comment from the technical editor or any of the designers.
The magazine offers $20.00 for each correction and this entitles me to $400 for my efforts. No payment has been provided to date.
But the important point is this.
The magazine should be including corrections and improvements in the following issues, just like the Australian magazines.
This shows responsible editorship and displays an understanding that EVERYONE MAKES MISTAKES.
It is fortunate that some of the "Professors" that I took to task, do not present their rubbish in the magazines any more and have desisted from presenting more of their designs on the web.
Their circuits simply DID NOT WORK and one professor said the voltage between base and emitter could be as high as 3v.
Obviously he has NEVER built a circuit in his life and when he saw my pages of corrections to his circuits, he pulled the plug on his website.
My main aim is to cover the basics of electronics as many designers lack these concepts and when confronted, are amazed there are design-rules and tolerances that make every circuit reliable.

It's funny that I don't have any disagreements with circuits designed by those with technical expertise.
I am not trying to find fault with circuits that don't have a fault.
I am highlighting circuits that are TECHNICALLY INCORRECT and showing how NOT to design a circuit and how NOT to make a fool of yourself.

Electronics for You has failed to reply to my emails. The CEO has failed to reply, the Technical "team" has failed to reply and the "Technical Editor" has failed to reply.
Electronics for You is a LOST CAUSE.
I didn't expect a reply. They have failed to reply to any of my emails for the past 4 years. I only expected them to fix up **Kits N Spares** websites where they have the same photo for 4 different kits, images of PC boards with "prototype" scribbled on the edge and boards with no overlay but hand-drawn numbering.
This is an absolute disgrace and would not be accepted for a prototype shown to electronics enthusiast. And they still want $50.00 postage for a $3.00 kit. It is obvious they don't get any overseas enquiries. Who is going to pay $55.00 for junk kit.
They have removed their electronics forum and sale of components. The forum was so messy and so under-used that you could not follow any of the requests.
If you look-up webtraffic: http://urlm.co/www.electronicsforu.com you will find their penetration outside India is 3.9% !!! It speaks for itself. They have been on the web for 17 years and only have a visitor tally that is twice Talking Electronics.
They claim a readership of 100,000 but they are selling their subscription for half-price and including a soldering kit, so they are effectively making no money on the subscriptions.
They can only do this to try and maintain readership to produce phony readership figures for the advertisers.
It's sad they don't have any respect for their hobbyist market. But they simply do not have any technical personnel to improve the website or provide any technical information. They can only come up with stupid replies such as: "**we can post your corrections on our website after we publish our circuits.**" I offered to review the articles BEFORE publication so the terrible designs would not be published. They obviously did not understand my offer.
You can tell you are talking to an absolute IDIOT when he says he has found your email in his SPAM folder.

This is the sort of intelligence you are talking-to at EFY. Why have a SPAM folder where you can miss important emails ???
There are some people you can help and there are some people you CANNOT help.
After 4 years of sending them corrections to their circuits, they have still failed to "pull themselves out of the mess."
I contacted their advertisers and distributors and did not get one single satisfied customer. They are all paying enormous amounts each month for advertising, with little or no return. But they are all living in the hope that next month will improve. WISHFUL THINKING.

Here is a statement from **Electronics for You** website:
Nearly 75% of the engineers passing out from various institutes are unemployable as they are severely deficient in practical hands-on training.
This confirms what I have been saying for years. It is too late to enter a course to get training.
Training starts at home when you are 8 years old.
Training starts with making projects. Lots of projects. It is the ONLY way to learn.
Electronics for You provides a Basic Electronics courses at a cost of 8 days salary for a 2-day course and a PCB design course showing how to make a single-sided board for a power supply.
A comment from a student: "***I would also like to take up an advanced PCB design course with some training on 2-layer and 4-layer PCBs, which is currently the need in the semiconductor industry***"
What is the purpose of the PCB training course???? Who designs single-sided boards???
I use 40 year-old CAD package because it is simple to use and does not "fall-over."
I can also combine boards from 20 years ago when making a panel.
You must use a package that is not frustrating.
On top of this you must use a PCB maker that is CHEAP.
I pay $2.00 per board for 10cm x 10cm and get 10 boards. Some manufacturers charge $20.00 per board. This is a RIP OFF. Every board is double-sided, PTH and silk screened. Every board is perfect. Cheap boards are absolutely perfect and anyone who says differently does not know what they are talking about.
I produced the first magazine in Australia to present projects using tinned boards with solder mask and legend. All the other magazines sold bare copper boards with no overlay!!!!! That's how far things have come.

Here's the clincher. I sent **Electronics for You** 4 articles and the reply was: "***most of them are written for those who are beginners w.r.t. microcontrollers, and the applications discussed have already been published though through a separate design***."
I don't know where he gets that STUPID comment from. None of my projects have even been presented before and no-one has explained how the circuits work to the extent of my description.
When you get IDIOTS like that being in charge of areas that are beyond their capability, you get a magazine that fails to deliver anything but JUNK.
The 3.9% acceptance by the rest of the world is an indication of how it is viewed. Even after 17 years of publishing, it cannot get a following that represents a percentage.

This is the sort of email I get every day from visitors to the site:

Dear Dr Mitchell,
I am teaching myself electronics and have been using your materials (pdf) on your website. I am writing to thank you for all that you have done in preparing these excellent teaching materials as an investment that benefits others.
When I was a kid I used to use the 500 in 1 electronics project kit and found it useful. I also found that while there are books out there (on Amazon) that teach electronics they tend to be very focused on the behaviour of each component and discuss them in depth. Though this is valuable I don't think it helps to teach how to construct circuits as a whole based on a problem or a requirement. I find you teaching materials such as 'transistor circuits' useful and like the step by step approach.

This message is also to encourage you and to show my appreciation.

Sincerely,

Marc Edwards

Marc R Edwards
Research Officer
Advanced Medical Imaging and Visualization Unit
Bangor University

I am not a Doctor, nor a Professor nor do I profess to know more than 1% of the electronics scene. But what I know is being delivered to you in a way that EVERYBODY can understand and showing how to "see" a circuit operating so you can analyse, test, design and FIX it.

I offered the same explanations to the management at **Electronics for You** and they refused to partake in any way.
Imagine the annoyance of the subscribers to the magazine if they knew they were being denied decent explanations and only being offered RUBBISH circuits that have been designed by incompetent muddlers and thrown into the magazine by "technical" staff that don't know a thing about electronics.
That's the only thing that disappoints me.
But it's the same throughout the world with doctors, politicians, banks and the courts.
They are **ALL** corrupt and everything they do and say is incorrect.
If you only knew the truth you would be horrified.
I have added a lot of my comment on these subjects in SPEED READING.

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SPOT
THE MISTAKES!
Page 22

Many readers have asked for more-complex projects.
I have already produced a number of fairly complex projects and they have received very little interest.
The readership of every page is recorded in a file by Histats and the 50 - 555 Circuits chapter gets 500 visitors each day, whereas the Basic Electronics Course gets less than 40.
The duration of each reader on a page is not recorded, however the mere fact that a complex project gets just a few readers each day, shows the interest dwindles for anything complex.
A recent quiz on an electronics forum asked the readers to identify the following:

Thermal Switch - or "cut-off"

At the beginning, some readers thought it was a transistor; one thought it had a positive or negative temperature co-efficient, a ceramic disc thermostat, a resistive temperature thermostat, and many other obscure answers.
The number of incorrect answers was surprising, even after many had correctly identified the object.
It highlights the fact that many readers can supply an incorrect response without first checking the details on the web.

I’m an engineering student. My professor required me to make a 7-segment display that start counting from 00-99 when hitting single switch. My professor only asked for logic gates IC like 7400, 7402, 7404, 7408, 7432, 7486 or simple OR, NOT, AND, NAND, NOR, XOR, etc. She also asked 555 timer for delays and used only the given IC. I already know the Karnaugh map values from a-g, so the question is how to make a 7-segment display from 00-99 with just single click on the switch with a delay from 555 timer?

My Answer:

This is a totally worthless assignment.
Time at University is expensive and very limited. Every effort has to go into producing the greatest outcome.
No-one has ever explained the real purpose for gaining a degree. The real reason is to produce a student who can make an impression on companies who are looking for new staff.
They are actually looking for those who will generate 2 to 5 times their salary.
Engaging a new member of staff is a commercial transaction and don't fool yourself otherwise.
That's why they really want an "electronics wiz" with 5 to 20 years experience.
But these are hard to come-by and they have to resort to a "second-choice."
The only reason you invest in a University degree is to get your "foot-in-the-door" without having 5 years experience in electronics.
If you think you know anything about electronics after a 5-year course, you are fooling yourself.
You probably don't even know how much room is required between a tall and short component to allow for wave soldering.
If you only complete 3 or 4 projects each year, the above task should be to produce a 2-digit counting circuit using a microcontroller, with up-down feature and a preset.
This is the type of counter used in packaging on production-lines.
I can understand using gates to produce a counter some 30 years ago, but times have changed.
I have had a lot to do with "Professors" and they are still living in the 70's and re-gurgitating concepts they learnt in the past.
Tell the "Professor" you are going to use a microcontroller and want help with the debounce routine.

Here are the most-common 3 mistakes of ALL TIME:
1. I know nothing about electronics, I have hardly built a project, but I will take an electronics course and become an ELECTRONICS ENGINEER!
You are fooling yourself if you think an electronics course will teach you anything or everything about electronics.
We see dozens of students on forums asking for advice on a final electronics project.
Even after suggestions they can hardly interpret a circuit diagram or source the components.
I have seen students emerge after a 3-year course, not being able to read a resistor or solder a surface-mount component. But they can read the load-line of a transistor - AND GET IT WRONG!
Students think the lecturer, the notes and text-book will turn them into an engineer. I have not found one text book that is vaguely related to understanding how to build and design the full range of the most-common building blocks.
Ten of my most-basic question are not answered in any text book. How can you possibly say a course will get you "into electronics?"

2. I will buy a CRO (or other piece of test equipment) to solve my circuit diagnosing problems.

This is a BIG MISTAKE. A Logic Analyser or Solid-State CRO will show all sorts of wave shapes but it will not tell you the location of the fault or which part of the graph is faulty. Sometimes it will lead you in the wrong direction! It is only helpful in the hands of an EXPERT.

3. With my "Master's Of Electronics" I will be able to design and build my own projects.

There is absolutely no relationship between fulfilling the requirements of a course and being able to design a successful project.
90% of students in their final years are just beginning to scrounge around and look for a "FINAL YEAR PROJECT." They are doing the wrong course.
I have 10 projects "on the go" at any one time and always waiting for 3 or 4 panels of PC boards to be made in China. One project sparks another and if you are not deigning one project after another, you are in the wrong profession.
If you think you will "learn on the job," you will miss out on being employed.
Only 1 person in one-hundred is really employable in a profession (we are not talking about counter-staff, or burger-flippers) and you need to be that 1%.

Spot the Mistakes adds a new dimension to teaching electronics. It explains why certain things cannot be done, (such as using a high-power transistor in an RF amplifier to replace a small current device - the circuit will simply NOT drive the high power transistor AT ALL).
We have already presented hundreds of circuits, shown how to test components, provided the basics to circuit design, and **Spot the Mistakes** fills in the final elements.
All that is left is for you to build something.
I have 15 projects on the go at any one time and many of them are waiting for the PC boards to come back from the manufacturers.
There are some very cheap manufacturers in China that cost less than $1.00 per board but you have to wait 10 days for the post to deliver the parcel.
I have explained this in the article PROTOTYPING BOARDS and covered the use of MATRIX BOARDS and how to start designing your own board with Protel software.
Electronics is one of the cheapest hobbies because you can re-use many of the components in the next project and the cost of parts has come down a lot due to eBay. You can buy everything on eBay and sometimes the postage is FREE.
You cannot compete with the Chinese.
They have copied the Western World to a TEE.
40 years ago, Philips and Germany were the leaders in component design.
The components from the US were UGLY. Fortunately China copied the European designs and now we have the best components at the lowest prices.
But it's no-good "LOOKING" at the components. You have to involve yourself and think of ideas. One idea generates another and after producing more than 1,000 projects, I have a whole list of ideas for the future.
You don't need a "CV" to get a job. Just write: " I have a box of 63 models and projects to show you in the interview" and you will land the job.

There is a small group of readers who have read nearly all the pages in this Spot The Mistakes section.
It is actually one of the MOST IMPORTANT sections you can read. You can learn 10 times faster from a faulty circuit than reading boring theory.
Here is an email received two days ago: (the spelling and grammar have been corrected)

My name is Hariesh and I am from India. I love electronics and I am an electronics enthusiastic who likes to build projects for my own use. The love of electronics was always in my blood as it started from my childhood. By profession I am a computer engineer. I previously searched online for different circuits and I tried to build them, but many of them did not work. A few weeks ago I come across your website and found "spot the mistake page." The folder was so lengthy (almost 24 pages). I have gone through all the pages and was really shocked to see the mistakes and untested circuits. I don't know how to express my thanks to you since the criticizer in you has revealed

many mistakes which will be useful for the people like me and it is really sad that most of the circuits you have spotted have been tried by myself and failed, without knowing that the circuit was just an idea and are not really tested. There are many circuits which are useful to me but many people will not point out the mistakes because they do not understand how the circuits work. But you are different from others. And off course I know that you may be disliked by many authors who publish wrong circuits. I believe they don't know how to deal criticism in a positive style and sports-man-like spirit. Imagine if nobody was there to criticize literature. How would we get great works like Leo Tolstoy? And when it comes to electronics, you are the number one who criticizes to get junk off the web.

The web is wonderful. It can inform everyone in the world to the latest technologies, no matter where they live. Everything is FREE on the web and you just have to pay for time at an internet cafe to download.
80 years ago this was called "School of the Air" where students had PEDAL RADIOS radios to listen to classes (in the outback of Australia). Hobbyists in 3rd world countries can now study and keep up with electronics and this will allow them to generate a skill to assist them in a career. Talking Electronics gets hundreds of emails from readers doing just that. Eventually they will get into the service and supply of electronics to help those in remote areas.
As I have said before, the web will be the eventual TEACHER of the world.

I am trying to build a warning speedometer that will be capable of driving an 8 ohm speaker and the speaker will sound at 60mph and the tone increases and interrupted 10mph thereafter. It must also show the values in 2 seven segment display. In addition I cannot used programmable chips. Can anyone please help me in my senior design project. I am struggling to build and design it.

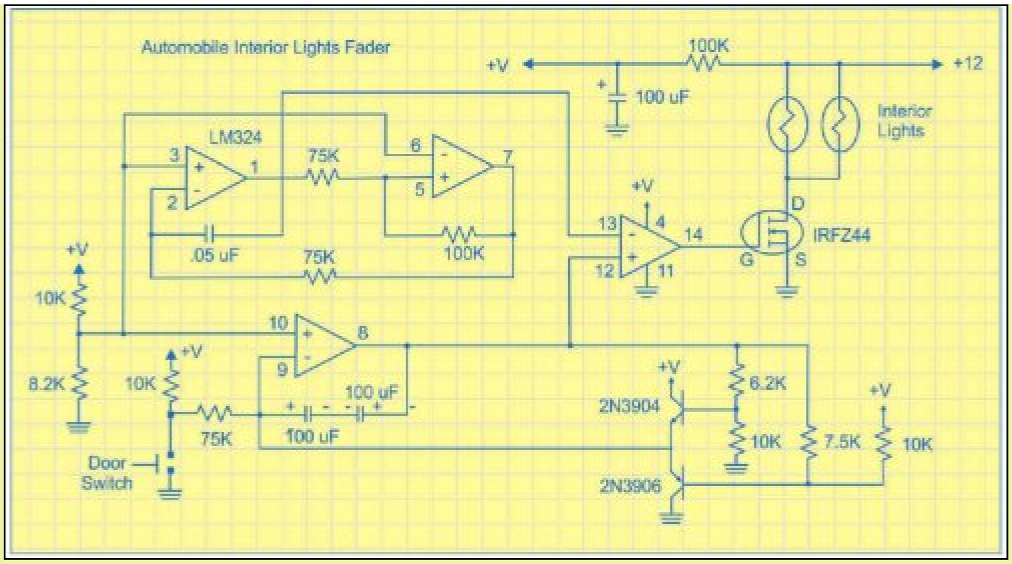
Where has he been for the last 3 years of his "**MASTERS OF ELECTRONICS**" course?

Either the course is poor quality, or the Lecturer is incompetent or the student is dong the WRONG COURSE.

With the introduction of the web there is absolutely no excuse for not referring to it on a daily basis and looking through the projects and circuits designed by others.
40 years ago there was hardly a source of circuits and major text books were expensive.
Everything is now FREE and if you expect to be successful in electronic design, it is too late to ask for help on a simple project like this, in your final course-year.
In fact we don't people like this, pulling-down the profession. Fortunately it is mainly reserved for people who understand electronics and anyone "bumbling along the bottom" will quickly exit the field.

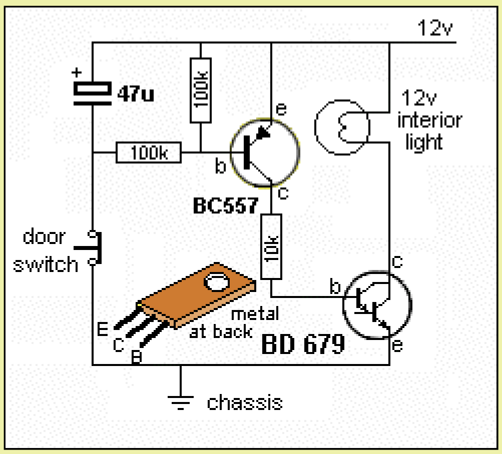
The lesson to be learnt is this: Don't think you can "fool your way" through a course. You have to be 100% successful to be a design engineer.
You can be a solicitor and never win a court-case. Or build a bridge and hope it will never fall down.
But an electronic device will not work if even with the slightest mistake. That's why you need to pay attention to detail.

CAR INTERIOR LIGHT FADER
The circuit fades the interior light after the door has been closed:



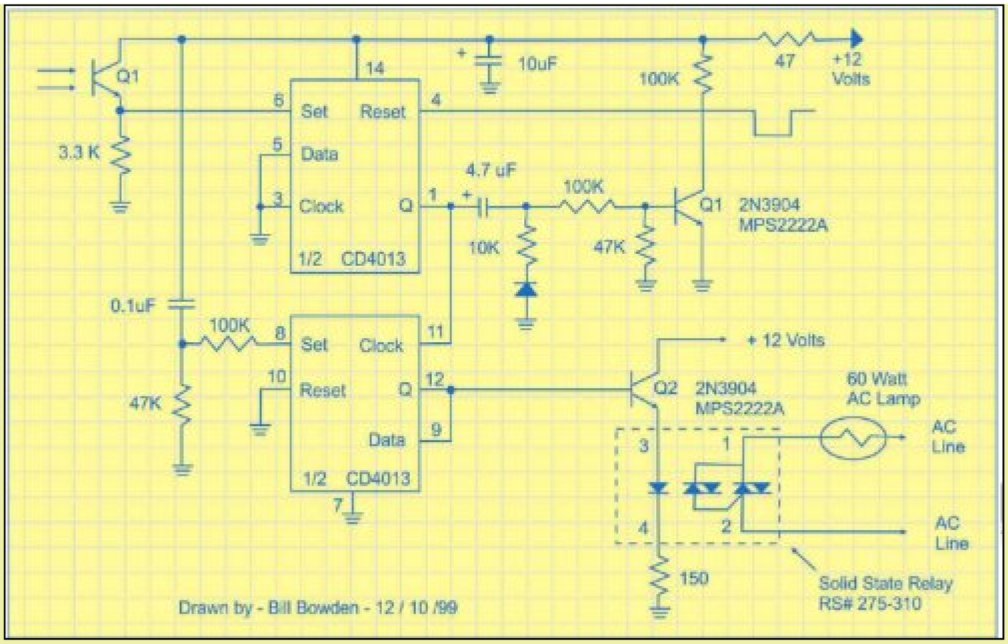
The circuit has lots of mistakes.
The 100k from the 12v supply supplies power to the op-amps. The op amp will reduce this voltage to almost zero.
The 10k and 8k2 will also reduce the voltage across the op-amp. The circuit DOES NOT WORK.

The circuit can be simplified to this:

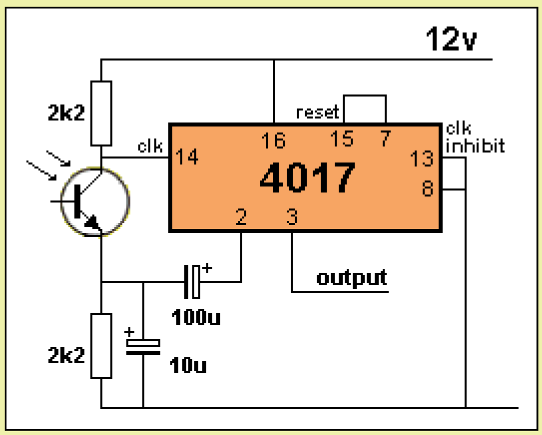


There is NO skill in producing a complex circuit.
Before you waste time designing ANYTHING, look on the web for circuits that have already bee designed and tested.

TOGGLE AN OUTPUT
The circuit toggles the output to turn the lamp on an off via a laser pointer.

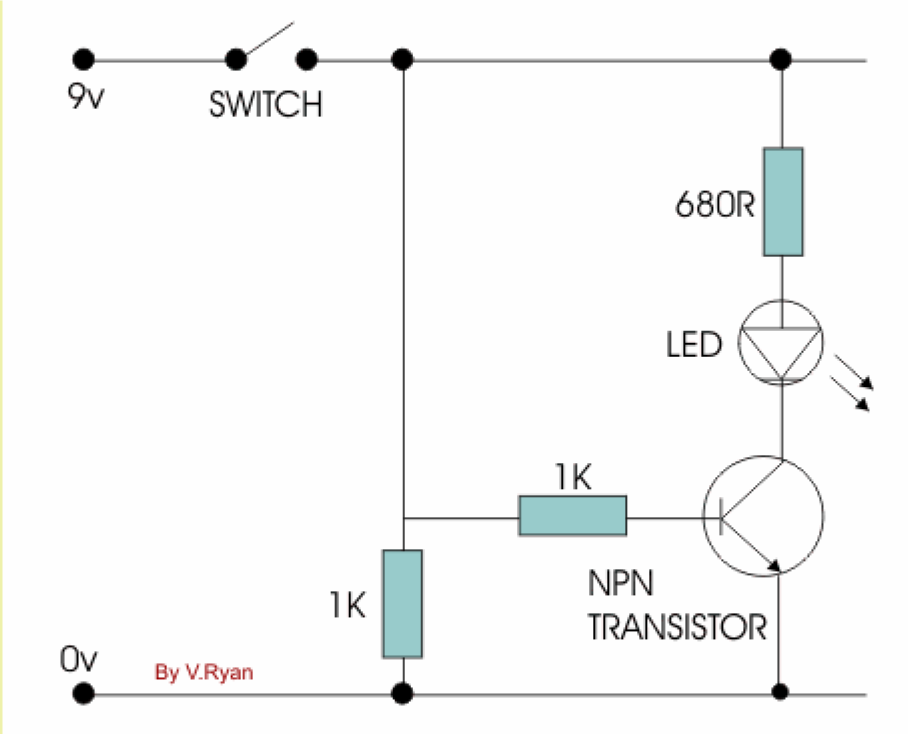


The circuit can be simplified to this:



The 100u creates a delay so the chip can only be clocked every second.

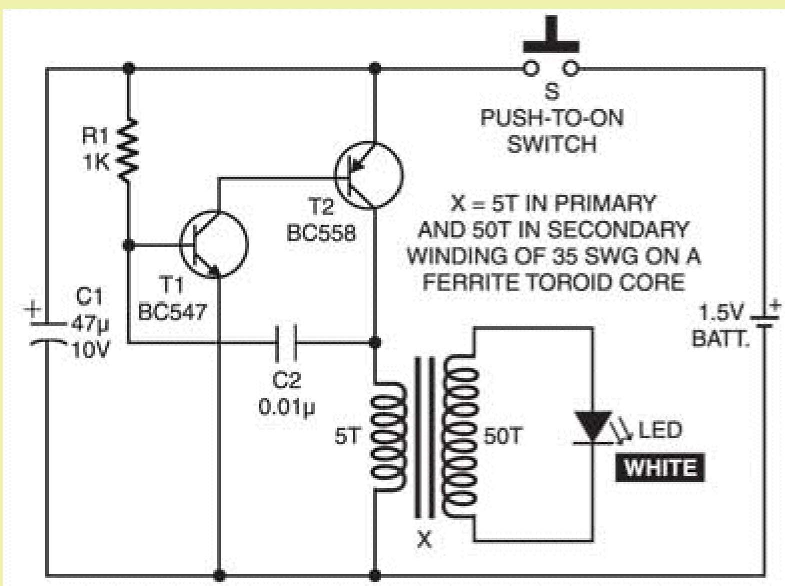
LED and SWITCH



Why does the LED take so long to come ON?? It should come on immediately. There are no capacitors in the circuit to delay the action. What is the purpose of the 1k across the power rails ??
Two mistakes that should not be in a simple demonstration circuit.

KEYCHAIN LIGHT

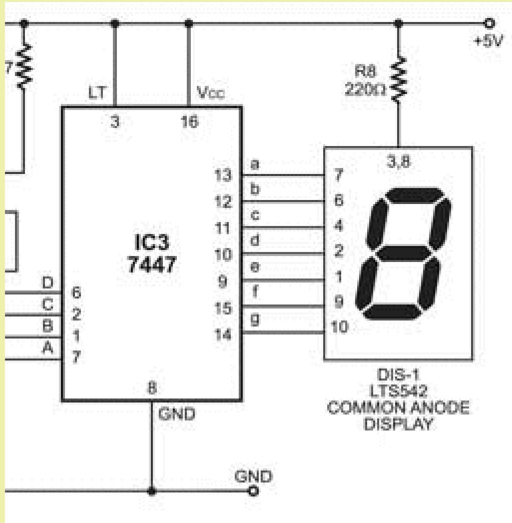
Here's another faulty circuit from **ELECTRONICS FOR YOU** Magazine:



It's an oscillator circuit illuminating a white LED from a 1.5v battery.
Why does the transformer have 50 turns on the secondary?
For each 5 turns on the transformer, 1.5v will be produced. The White LED only needs 3.6v.
If the supply drops to 0.9v, each 5 turns will produce about 0.65v after the collector-emitter drop of the PNP transistor and you only need about 30 turns.
There is no current-limiting resistor in the path made up of the emitter-base of the PNP transistor and collector-emitter of the NPN transistor. When both these transistors are turned ON the voltage drop will try to fall as low as .065v + 0.25v due to the junction-voltages and this will cause a very high current to flow.
This is wasted current and could be more than the current flowing through the transformer to illuminate the LED.

7-SEGMENT DISPLAY

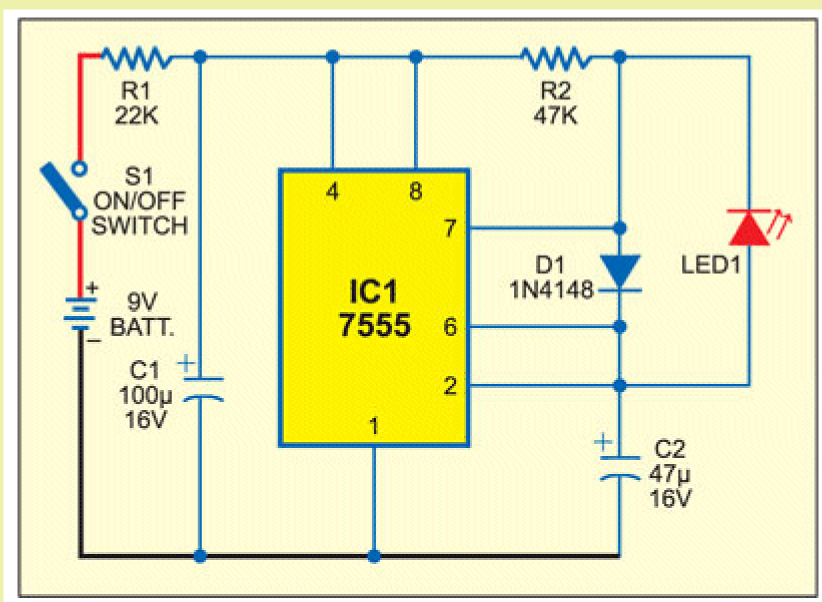
Here's another badly-designed circuit from **ELECTRONICS FOR YOU** Magazine:



When one segment is illuminated, it will get about 15mA via the 220R resistor.
When 2 segments are illuminated, they will get 7.5mA each.
But when 7 segments are illuminated, they will get less than 2.2mA each and the whole display will be very dull.
This will be obvious when you build the circuit and it shows the circuit has never been constructed !!

7555 FLASHER

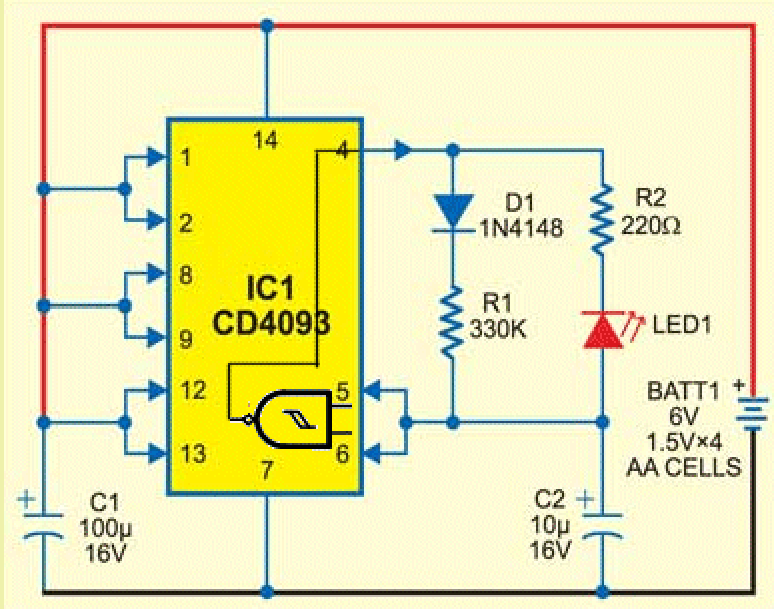
Here's another badly-designed circuit from **ELECTRONICS FOR YOU** Magazine:



Apart from the absurdity of flashing a red LED from a 9v battery, the discharge pin (pin 7) of a 7555 IC is not designed to pass a high current.
The 47u charges to about 6v and its energy is passed directly to the LED when pin 7 goes LOW. This produces a bright flash. But pin 7 is not designed to do this.

CD4093 FLASHER

Here's another badly-designed circuit from **ELECTRONICS FOR YOU** Magazine:



The diode serve NO PURPOSE. The LED discharges the 10u very quickly and the 330k charges it very slowly.

TL431

Here's another badly-designed circuit from **ELECTRONICS FOR YOU** Magazine:

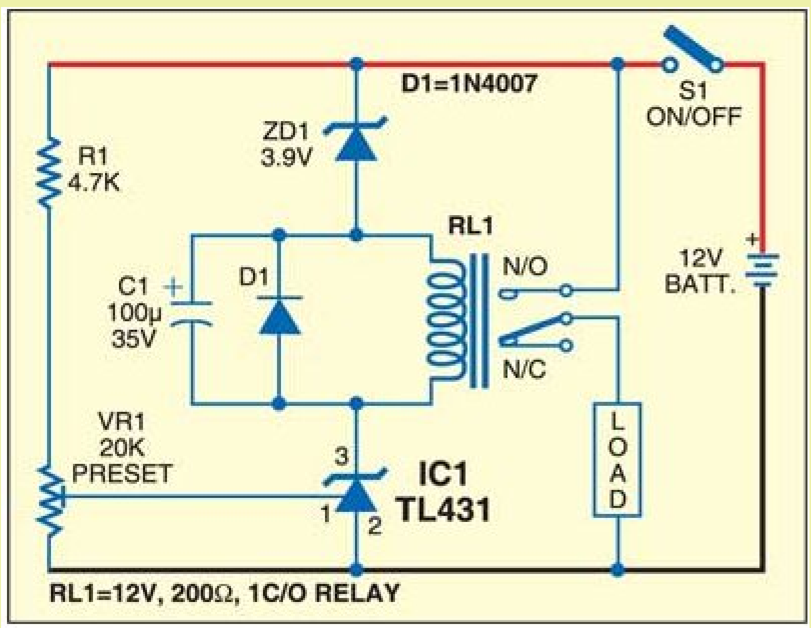


Fig. 1: Battery protector using a shunt regulator

TL431 is possibly the WORST device you could use to detect battery voltage as the voltage only has to rise a few millivolts and the device changes state.
You need a wide distance between the circuit turning ON and OF and then ON again because the voltage of a battery will rise as much a 0.6v when the load is removed.
This is called the HYSTERESIS GAP.
This circuit will switch ON-OFF-ON-OFF. Some circuits will work due to the 3v9 zener only allowing the relay to see 8.5v when the battery is fully charged. But some 12v relays will still pull in at 6-7v.

40kHz Transmitter

Here's another badly-designed circuit from **ELECTRONICS FOR YOU** Magazine:

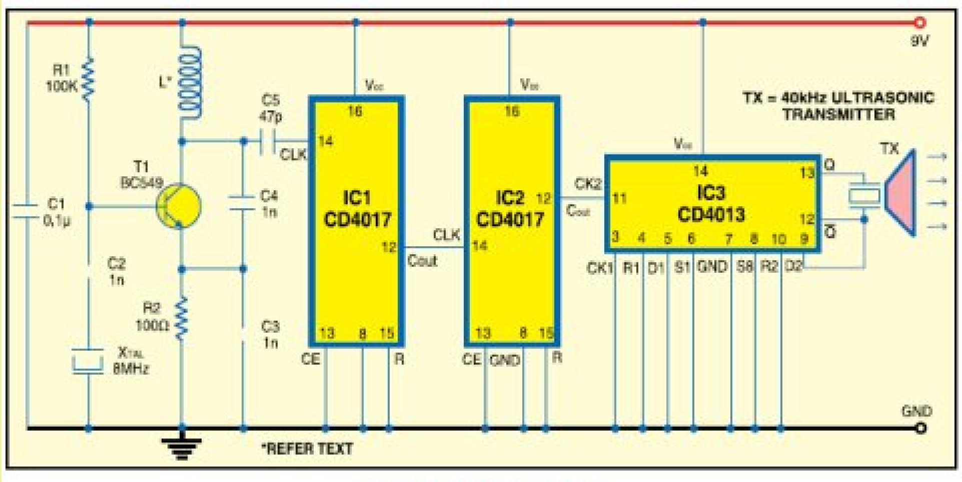
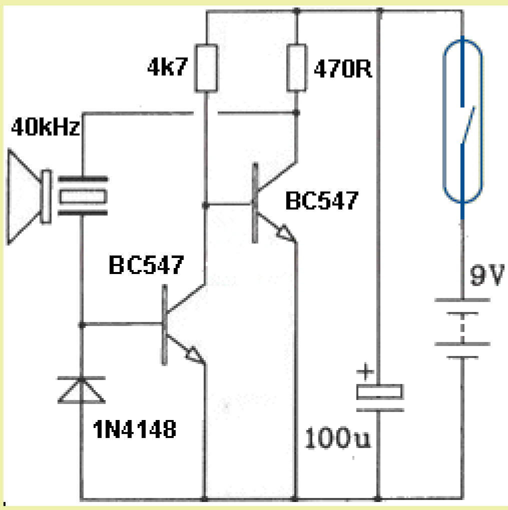


Fig.1: Transmitter circuit

The complex circuit above can be simplified to:



This is a typical example of failing to search the web for a simple circuit before launching into something complex.
As I have said before, there is no skill in producing something complex.
You need to do your homework to find out the absolute minimum number of components required to perform a particular task.
The transistor oscillator circuit automatically oscillates at 40kHz because the transducer operates as a CRYSTAL and it's just like a CRYSTAL OSCILLATOR. How simple and how clever !
All these "tricks" are very important to remember. You will never find them in any text book. That's why this "Spot The Mistake" section is so important. It covers things that cannot be covered anywhere else.

Here is a circuit from a 1985 Indian book on LED circuits. I was going to put it on the web, but it contained so many mistakes that it would confuse many readers.
Here is a circuit that is up-side-down:

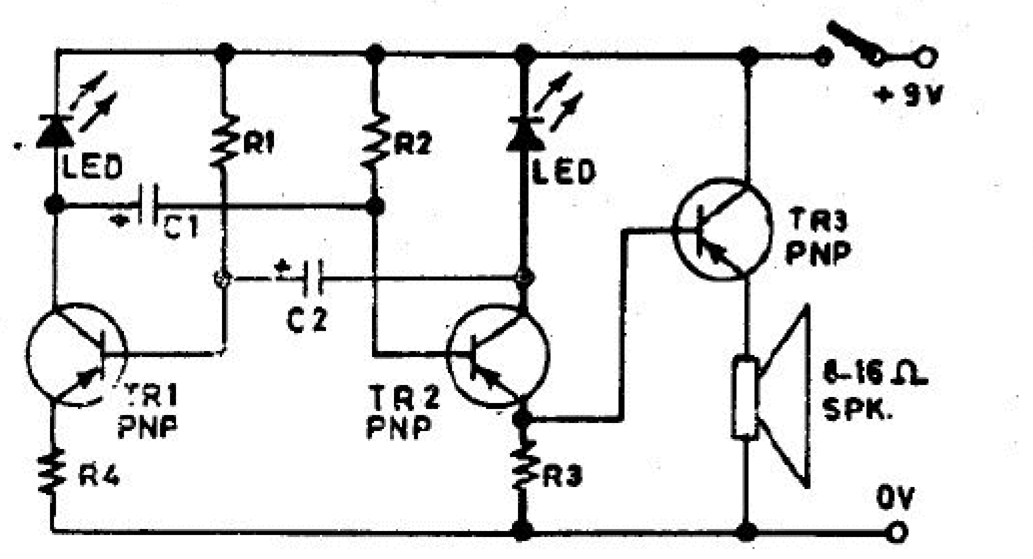
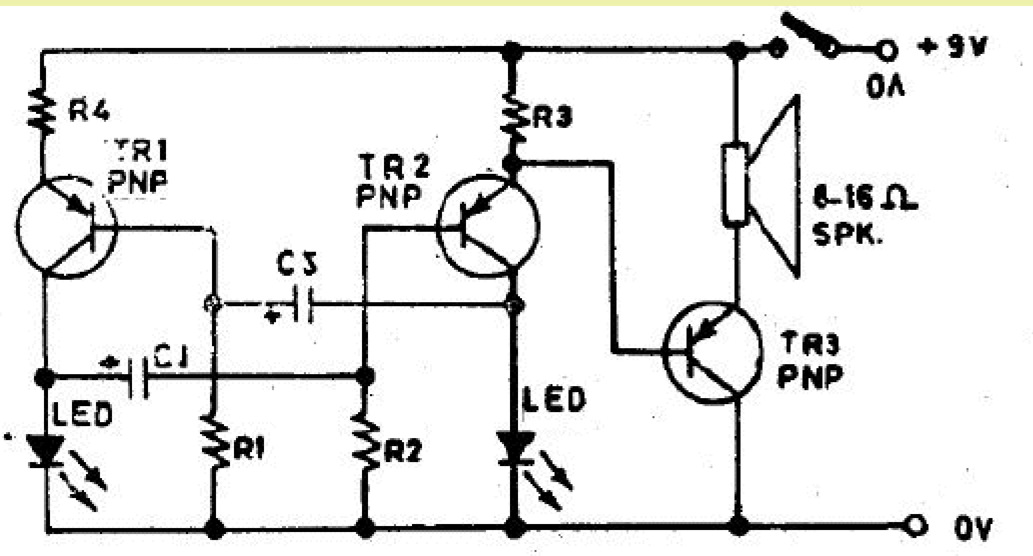


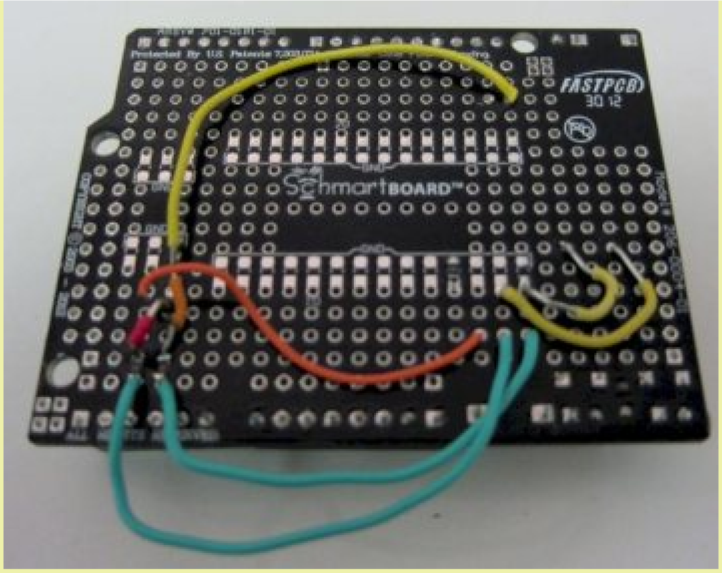
Fig. 6.3. Collector Coupled Multivibrator Flasher.

I could not see if the circuit above worked, so I turned it around the correct way:



Build the circuit and see it it works.   Use 470R for R3 and R4   and 22k for R1 and R2.   47u for the electrolytics.

From **Gary Crowell Jr** Technician and Electronics Enthusiast



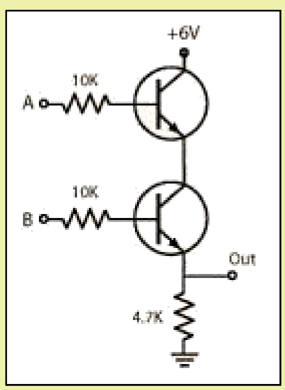
It is easy to connect to each pin from your IC to components on the SchmartBoard

If any of my workers soldered jumpers like the photo above, they would be sacked ON THE SPOT.
I have never seen such as disgusting mess in all my life. Doesn't Gary have any respect for his responsibility as a technical person, to show how to produce a quality project ????

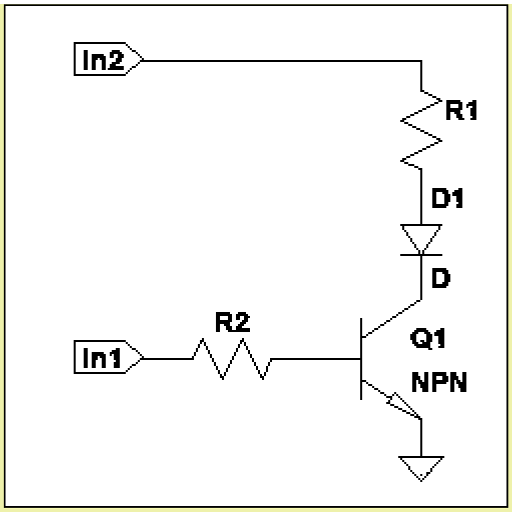
There is one area we have not covered on our Talking Electronics website. It is CLEVER DESIGNING.
That's why we have put the answer here.

How can I connect a led to two outputs and it only illuminated when both outputs are HIGH?

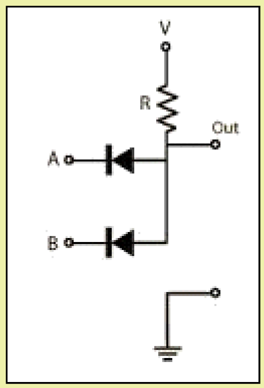
Here is the first answer:



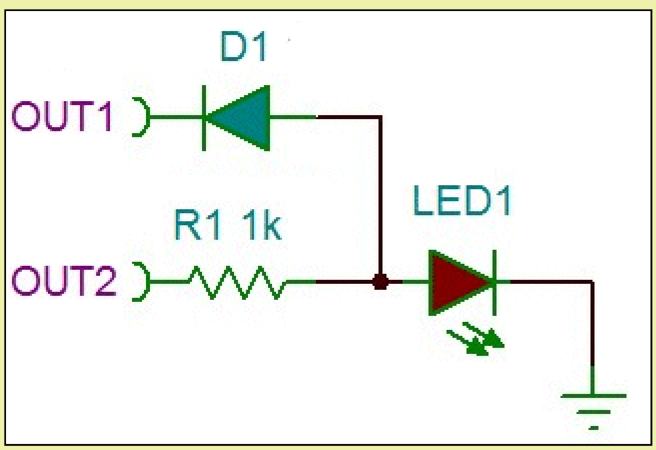
Here is the second reply:



Here is the third reply:



Here is the fourth reply:

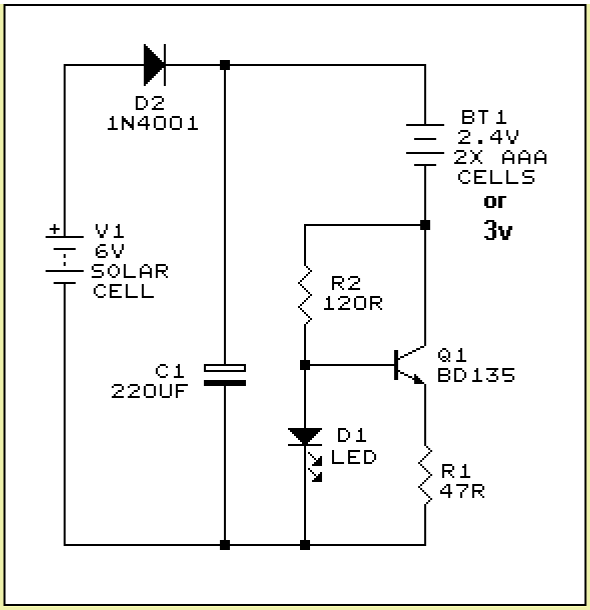


As you can see, the answers get simpler and simpler. Some results have a different effect on the load on the outputs and the quiescent current consumption, so the simplest answer may not be the best.
But it is interesting to see 4 different results for a simple requirement.

Here is a discussion from a forum.

I am doing this little project, is a solar charger for 2 AAA Batteries 550maH.
The power supply will be a 6V 100mA solar cell.

Here is the circuit:



The first reply, stated:

D2 protects the circuit against reverse polarity and also prevents the battery from discharging into the solar cell when it's dark. C1 is a smoothing capacitor.
The circuit built around Q1 is a simple constant current sink. When sufficient voltage is available from the solar cell, R2 biases Q1 ON and current flows into the rechargeable cells.
If the voltage between Q1 collector and the negative rail starts to approach around 1.8~2.0V, D1 will start to illuminate. If your solar cell is able to produce about 4.8V or more, D1 will limit Q1's base voltage to about 1.8~2.0V (assuming it's a standard red LED) and this will limit the voltage across R1 to about 1.2V, limiting the charging current to about 25 mA (from I = V / R with V=1.2 and R=47).
If your batteries are rated at 550 mAh and your solar cell is producing at least 4.8V, the batteries should charge from fully flat to fully charged in about 22 hours (calculated from 550 mAh / 25 mA).
The circuit does not detect when the batteries are fully charged. It will continue to charge them at 25 mA while there is sufficient voltage from the solar panel. This is a "trickle charge" and will not damage them since it's only 1/22 of their 1C charge current.

My reply:
If the solar cells are 100mA you need to have a circuit that uses the available current.
You just need a diode and connect the solar panel directly across the 2x AAA cells. Take them off after a days sunlight.
Why wait 3 days to charge 2 AAA cells?????
What waste 75mA ??
Why buy a 100mA solar panel and only use 25mA ??

2nd reply:
A spec of 100mA only means the solar cell is able to deliver up to 100mA before seriously dropping in voltage.

This is entirely WRONG
In fact a solar works exactly the opposite.
As the sun shines brighter, the voltage and current from a solar panel (solar cell) increases and it will magically adapt to any battery it is charging. It is best to have the battery voltage near to the maximum voltage produced by the panel but the panel needs to have at least 6v extra available to cater for the floating voltage produced by a battery and allow the extra voltage produced by the panel to convert to current.
It is only when the maximum voltage produce by the panel is achieved, will the maximum current flow.

3rd reply:
A solar cell is a voltage source. It will deliver current to a load as long as the rated current of the solar cell is not exceeded.

This is WRONG
You cannot exceed the rated current of a solar cell. If the panel is 100mA, it will never deliver 150mA.

The replies then get mixed up with a LOAD on a solar panel and a battery connected across the panel.
A battery being charged is not the same as a LOAD. A load conforms to Ohm's Law and as the current increases

through the load, the voltage across it increases.
A battery is similar to a zener diode.
No current flows until the voltage produced by the panel is greater than the voltage of the battery and when the sun increases in brightness, the voltage produced by the the panel would increase. But in this case the battery voltage does not increase (only very slightly) and the current increases until it is the maximum the panel will deliver.

Finally, the reply from one of the moderators:
In your case I think your best option is to charge the cells directly from the solar panel with just a diode in between them.

That is EXACTLY what I said.

The last 2 replies were then magically removed from the forum because the Moderators realised they had made such a mess of their answers.

In fact you don't even need the diode. If it is very sunny day, the cells will be charged in 6 hours (if they are fully discharged) and removing them from the charger will mean you don't need a diode.

Here is another STUPID circuit from **ELECTRONICS FOR YOU** September 2014
It is an EMERGENCY LIGHT that is supposed to operate from a 1.5v cell that is "almost dead."

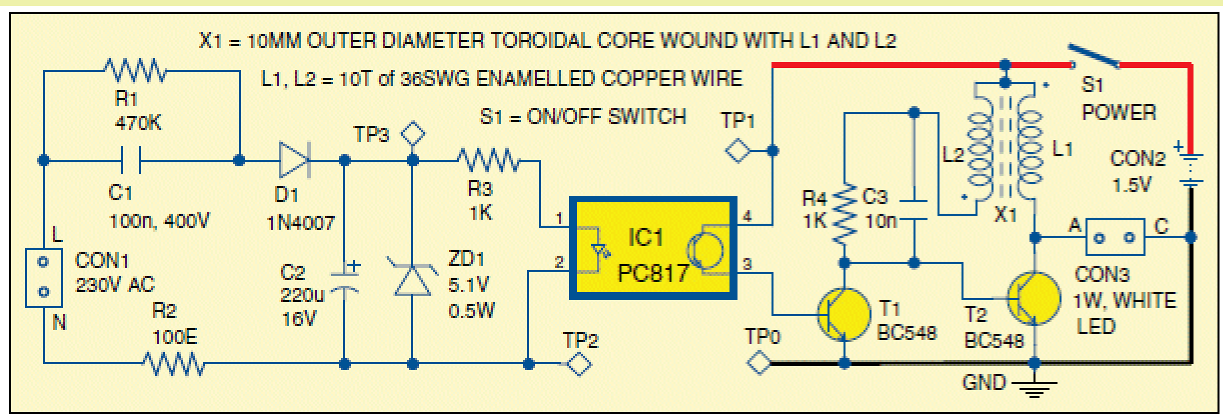


Fig. 3: Circuit diagram of the emergency light

Half the components in the AC section can be removed. The zener diode and 1k are not needed as the LED can be across the supply from the 100n and the power diode will discharge the 100n when it is across the LED with the cathode to the 0v rail.
But the worst part is the Joule Thief circuit.
The circuit is supposed to be connected to the battery all the time so it turns ON when the AC fails. That's the whole point of the circuit.
But when the switch is closed, current flows through the transistor in the opto-coupler and base-emitter of the first transistor and the battery will be flat in a few days!!
These two components will allow anything from a few mA to 100mA or more to flow as we don't know the conduction of the transistor and the base-emitter junction will drop only 0.7v. There is no current-limiting resistor in this circuit and this type of arrangement must be avoided totally.
These two transistors are like turning on all the taps in the house so the garden tap wont drip.   There are keeping the circuit turned off by wasting 100mA !!!
But the worst part of the circuit is the BC547 transistor driving the oscillator.
This transistor will only pass 100mA and since the circuit is only delivering spikes to the LED for less than 50% of the time, the average current will be 50mA.
A 1watt LED draws 300mA @ 3.6v. This is 600mA @ 1.5v and the transistor would have to pass 1.2 AMP to generate full brightness. How are you going to get anything like 1 amp from a old cell?
This circuit is far from suitable for driving a 1 watt LED and no-one has tested it to see how useless it is and the fact that it will flatten the battery when waiting for the AC to fail.

Here is the absurd description of how the transformer works:
When switch S1 is closed and the battery is connected at CON2 (and AC mains supply is not available), current flows into the base of transistor T2, the voltage across its base and emitter rises and the transistor is switched on. This means that a larger current can now flow through primary winding L1 of transformer X1 and then through the transistor. This collector current generates a magnetic field in the toroidal transformer

in a direction opposite to the field created by the base current through its secondary winding L2.
This is totally false. The current created in the feedback winding is in ADDITION to that provided by the 1k and turns the transistor on HARDER. So he has absolutely NO IDEA how the circuit works.
As soon as the primary current becomes greater than the secondary current, the voltage on the secondary winding reverses which, in turn, switches off transistor T2. **Absolute RUBBISH**.
The magnetic field collapses and white LED is switched on. This allows the 1W white LED to be lit from a single 1.5V/1.2V battery, which otherwise requires a 3.2V DC source or more.
The explanation is totally FALSE. I know the operation of the transformer is complex, but to dish out this sort of rubbish to 40,000 Indian readers is a disaster. But, then, none of the staff at **Electronics For You** have any idea how the transformer works either.
See our **LED Torch Projects** for the operation of a Joule Thief circuit.

RADIO SHACK FINALLY DIES

RadioShack is running out of cash and will end up in bankruptcy court after a long, gradual demise.
RadioShack has always been a terrible place to buy anything electronic.
It has never been a good electronics store and was only kept alive with a few of its good products, like **200-in-one** electronics kits, gold detectors and CB radios.
Their computer products were successful for a time but the market was taken over by the IBM PC due to the enormous number of programs that were developed for the clone version of this computer. See TRS-80, http://en.wikipedia.org/wiki/TRS-80_Color_Computer. The other major failure of the company was the quality of the components. There were always "sweepings off the floor."
Putting 5 resistors in a pack for $2.00 is not cheap and selling a 555 for $1.99 is only for an idiot buyer.
At one stage (over 30 years ago), their major sales were components as CB radios died due to mobile phones, the computer market was dominated by the IBM PC and the demand for sound systems died due to many factors.
Their books were also very poor but the books from a prolific writer Forrest M Mimms III must have contributed to 50% of the overall sales.
The company never added to his range and I wrote to their head office over 30 years ago with a book proposal and NEVER GOT A REPLY.
That's how incompetent that are.
Tandy deserve to GO UNDER - DIE - BITE THE DUST - DISAPPEAR.
They have been a blight on the market ever since their inception and every since their attitude to electronics hobbyists.
They have done nothing to advance the cause and it is no wonder Dick Smith was able to come in and scoop the market.
Tandy was always a "junk shop" with everything HALF FINISHED. At one stage you could buy some parts for kits (at enormous prices) but not all the components.
They had NO professional intelligent electronics person in head office and yet there were 120,000,000 Americans living in the US at the time.
You would think one person would "stick his head up" and say: let's produce an electronics magazine ON ELECTRONICS, for electronics experimenters and sell them in the stores and get 300 enthusiastic customers to each store each month.
They could have introduced a book club, a kit club and an electronics club at NO COST and yet absolutely NOTHING was done.
That's the intelligence of the American.
The only reason ANYTHING succeeds in the US is due to the enormous population.
Nearly everything is extremely poor quality but the enormous amount of "foot-traffic" keeps the shops open.
They don't have to sell quality, just variety.
And Tandy is an example of RUBBISH.
That's why they have finally bitten the dust.

SCUM

It's only happened a few times where readers have ordered a number of kits and presented a bogus credit card.
That's why I have stopped taking credit cards and only use PayPal.
But recently kent winchester of kentwinchester77@gmail.com sent me a request for 500 Metal Detector projects.
I asked him who he was going to sell them to and he replied:

I have customers. And I want to recommend you to a shipping company that will be able to ship the packages to my client destination. The shipping company email address is : LTLfreightshippingcompanies@outlook.com . I want you to email them and find out the freight cost as soon as you have it email me with the total and I will submit my

credit card for you to run and have the materials shipped out asap.
I will be expecting a reply from you.

Shipping Address Street Wabbitwatchin Excursions City, Pósthólf 1034 Country,ICELAND Postal/Zip Code,Pósthólf 1034

He did not ask for samples or anything about the kit and this seemed strange.

I immediately Googled kent winchester SCAM and up came a huge page of scams.

It works like this:
The customer is asked to send a big consignment to a warehouse using his shipping company. The shipping company does snot exist. He is the shipping company.
He pays you with a stolen credit card and you pay the shipping company with your own credit card within a few hours of getting his card details.
Kent Winchester gets payment for shipping and instantly removes the money from the shipping account.
You send $6,000 worth of goods to a bogus warehouse and lose $1,000 in shipping costs.
It's a simple SCAM that has cost a lot of people a lot of money.
http://glassmagazine.com/glassblog/warning-fake-shipping-company-scam?page=3

This is a set of conversations taken from an electronics forum:

I have a variable power supply, used to test motors and run accessories (motor & tire lathe's) for Slot Cars.
The power supply as it came from the manufacture had a 6.3v 6 amp transformer. I needed a bit more current, so I installed a 12.6v 8 amp transformer in the case.
The Linear Voltage Regulators that came with the power supply are LM350T's, 3 of them wired in parallel giving me 9 amp capability.
The power supply is designed to use the case as a heat sink and it runs REALLY hot,. There is no fan to move air over the case. I want to see if there is something I could do to cool the case.

The first three replies suggested going back to a 6.3v 8-amp transformer, adding a fan or using a power supply from a lap top.

Hardly realistic solutions. The other suggestions involved adding a heatsink to the inside or outside of the case but the person did not want to go to all the extra work.

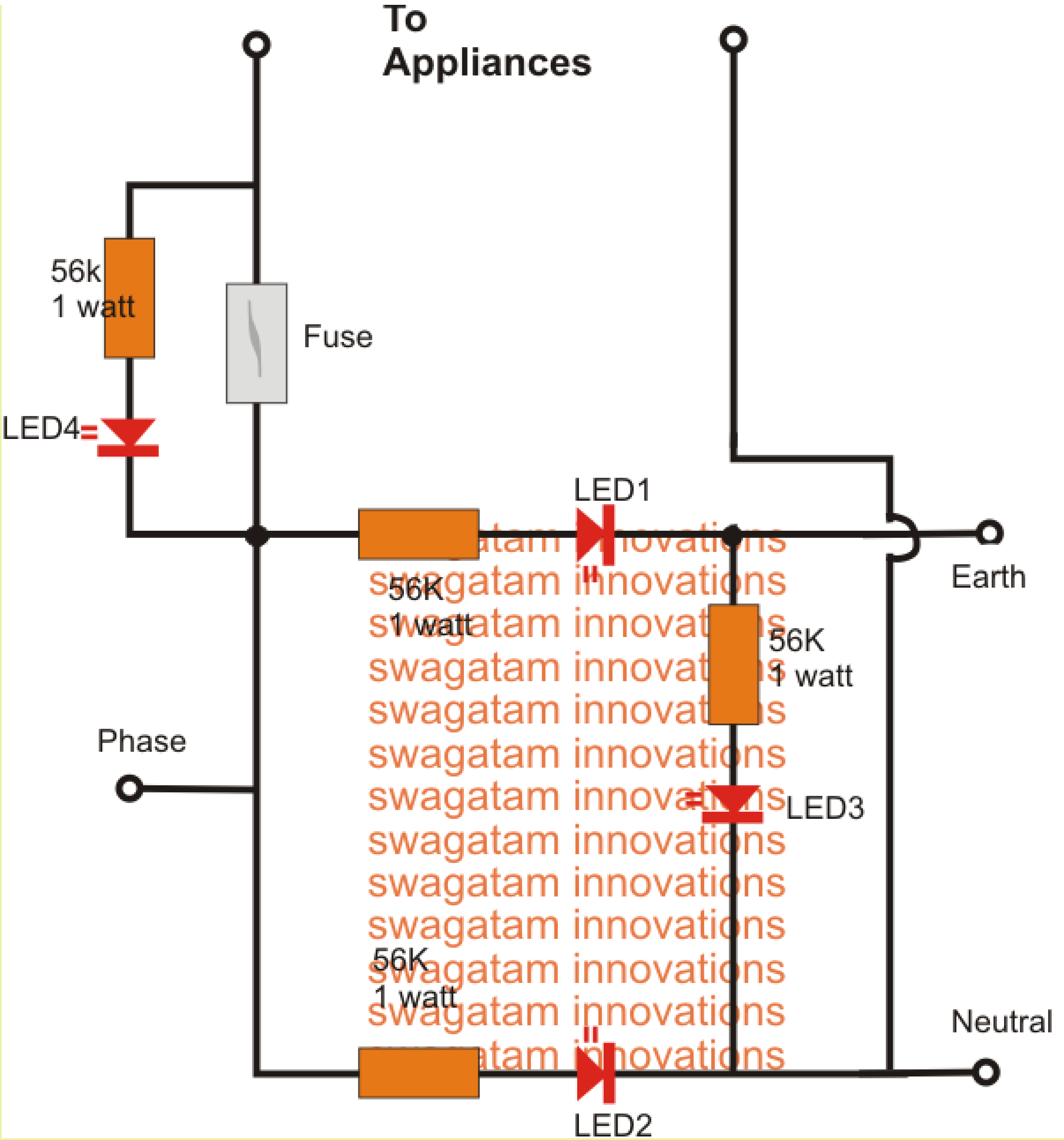
I suggested adding a number of 10 amp bridges between the transformer and the bridge in the case, in an arrangement called "Daisy Chaining."

Daisy chaining multiple bridges together will merely result in only half of the other bridges actually being used... You should do away with that idea, and if reducing the voltage to the regulators are the proposed solution, wouldn't the better options be a new transformer, reducing the coils on the secondary, or cascading diodes after the bridge?

There are 4 mistakes in the reply. Adding additional bridges drops about 1.4v per bridge and even though only two diodes in each bridge are used, the whole idea of the bridge is to remove 1.4 x 8 = up to 11 watts from the regulators.
Eleven watts is an ENORMOUS amount of heat and the bridge is easy to fix to the case with a screw. Individual 8 amp diodes are called stud diodes and these need to be screwed to a heatsink and are not insulated or isolated, so individual diodes are a bad suggestion.
Replacing the transformer is out of the question and removing some of the turns on an 8 amp transformer is a very difficult thing to do.
The only economical answer is to add some 10 amp bridges and place them away from the regulators and on very good heatsinks to evenly distribute the heat.

Here is another faulty circuit by Swagatam Majumdar

The reverse voltage on LEDs 1 and 2 will BLOW THEM UP! Phase is also called "ACTIVE."



Here's a website with over 1,000 projects:

I have included it here because some of the projects don't work. Some of the links don't work and some of the circuits are so small you cannot read the values.
However it is good source of information and ideas. Some of our circuits are also on the site.

Here is a website with all the old USA electronics magazines:
http://www.americanradiohistory.com/Popular-Electronics-Guide.htm
http://www.americanradiohistory.com/Radio_News_Master_Page_Guide.htm
http://www.americanradiohistory.com/Electronic_World_Master_Page.htm
http://www.americanradiohistory.com/Radio_Electronics_Master_Page.htm
http://www.americanradiohistory.com/Electronics%20_Illustrated_Master_Page.htm
http://www.americanradiohistory.com/Radio_Craft_Master_Page_Guide.htm

Here's some more mistakes from **ELECTRONICS FOR YOU** Magazine October 2014:

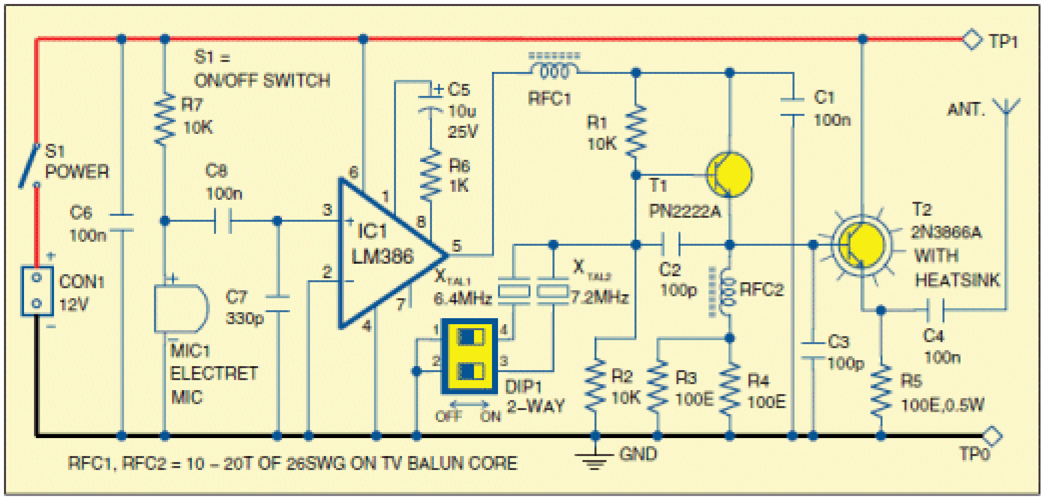


Fig. 1: Circuit diagram of the crystal controlled AM transmitter

The value of R1 is far too low. Electret microphones are very sensitive and only need a very small current for the operation.
A load resistor of 100k is needed for 12v supply and if a low-resistance is used, the microphone starts to produce a lot of background noise.
What is the purpose of R2 and R3 in parallel????
A 47R can be used.
The output transistor has a heatsink. Why??? The maximum voltage-on the base is 6v as it is being driven by the emitter-follower transistorT1 and the base of this transistor has a voltage-divider of 10k and 10k on the base.
The maximum voltage across R5 will be less than 6v and this will allow a maximum of 60mA to flow. The wattage will be a maximum of 35mW and the transistor will not heat up AT ALL. The loss in R5 will be a maximum of 35mW, so why is a 500mW resistor specified.
These are the sort of mistakes that show the designer has NO electronics ability and the technical staff at **Electronics For You** Magazine have no understanding of electronics either.

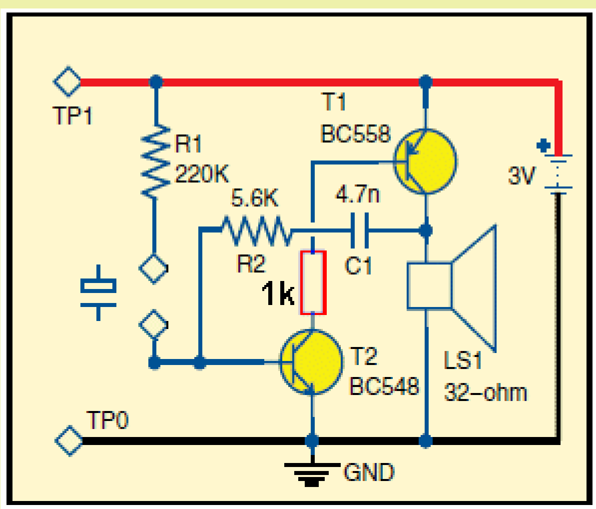
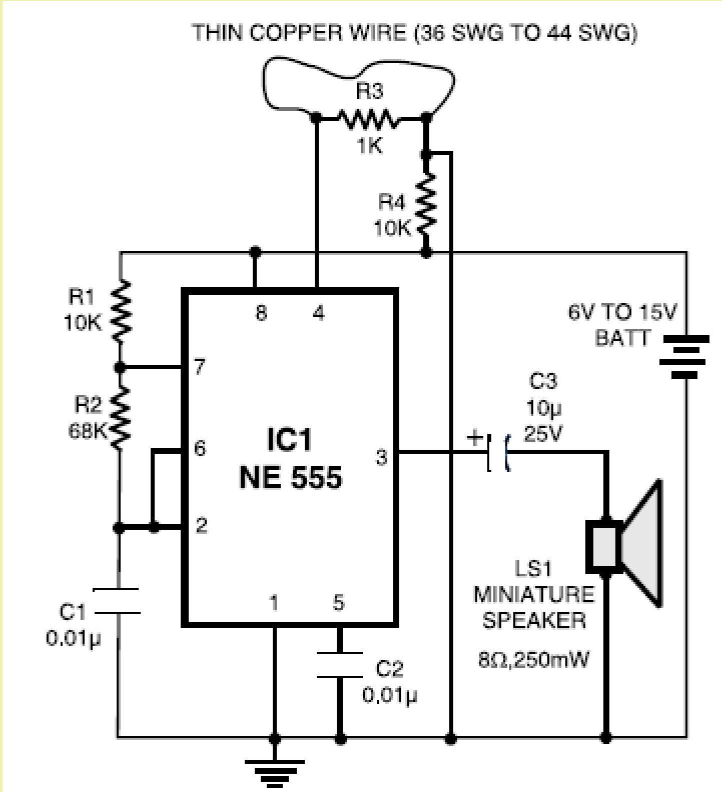


Fig. 1: Circuit diagram of the capacitor tester

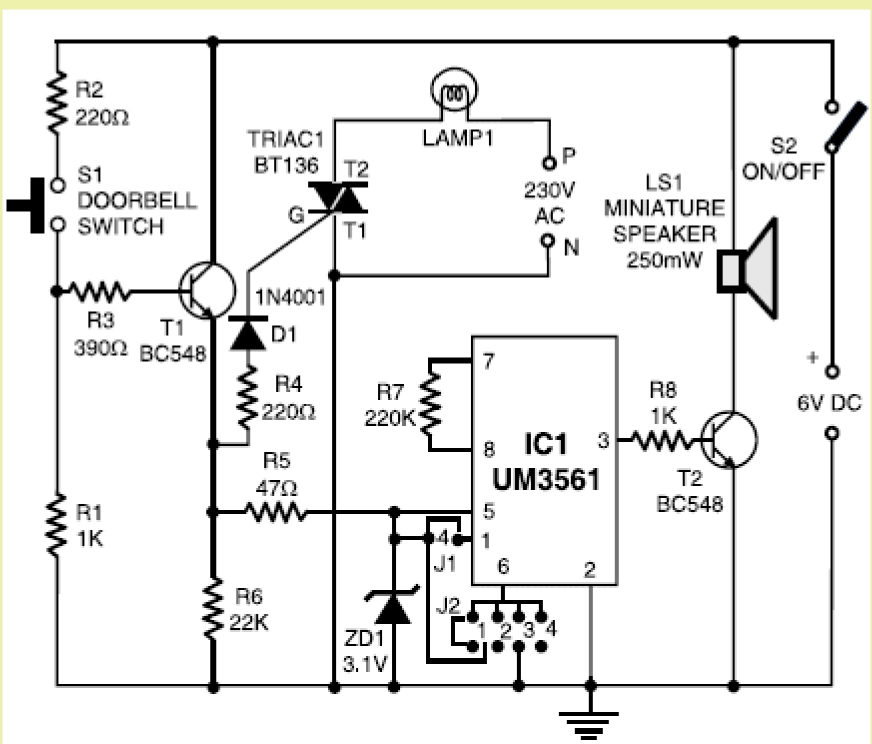
Although this circuit is very handy, it had one major mistake. The two transistors were DIRECTLY COUPLED.
This means a very high current will flow though the emitter-base junction of the BC557 and collector-emitter junction of the BC547 when the two transistors are turned ON.
This may not be important for a 3v supply, but shows a lack of understanding on how to design a circuit.
A 1k resistor has been added to prevent this high current flowing and is shown in red on the diagram above.
I have already pointed this problem out to a design engineer and he agreed, the current reduction was considerable.
The faulty circuit should NOT be published in **Electronics For You** Magazine.

Here's a typical example of why you should draw a circuit so it is easy to understand:



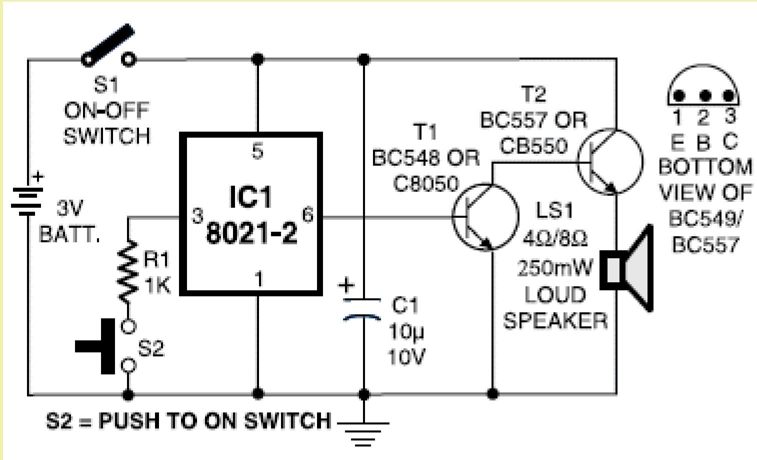
Look at the thin copper wire. When it breaks the reset pin of the 555 goes HIGH and the chip turns ON.
But look carefully at the circuit. Does pin 4 rise higher than 0v ????

Here we have a TOTALLY ILLEGAL circuit from CHIP TALK eBook

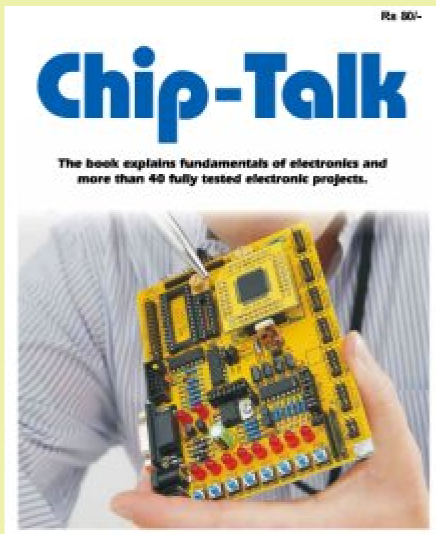


You are not permitted to connect the neutral wire to the earth. These must always be kept separate.
This circuit has the active lead (P) connected to the circuit and eventually going to the doorbell switch without ANY ISOLATION. A doorbell switch is not rated for 240v operation and anyone pushing the switch can get a shock if a fault occurs.

The top transistor should be drawn as a PNP: from CHIP TALK eBook



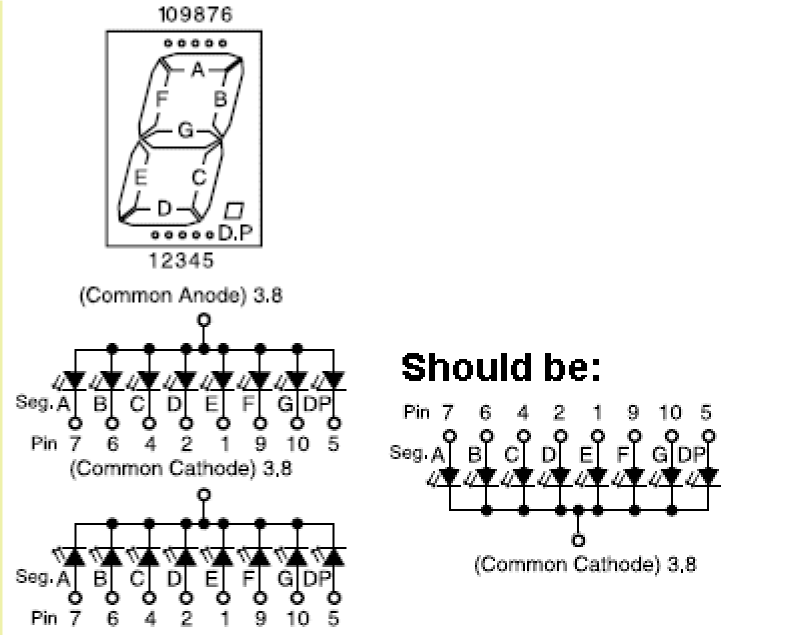
Here is the cover of CHIP TALK eBook.



The cover has nothing to do with the simple projects in the book. It is just another fraudulent con from **ELECTRONICS FOR YOU** magazine.

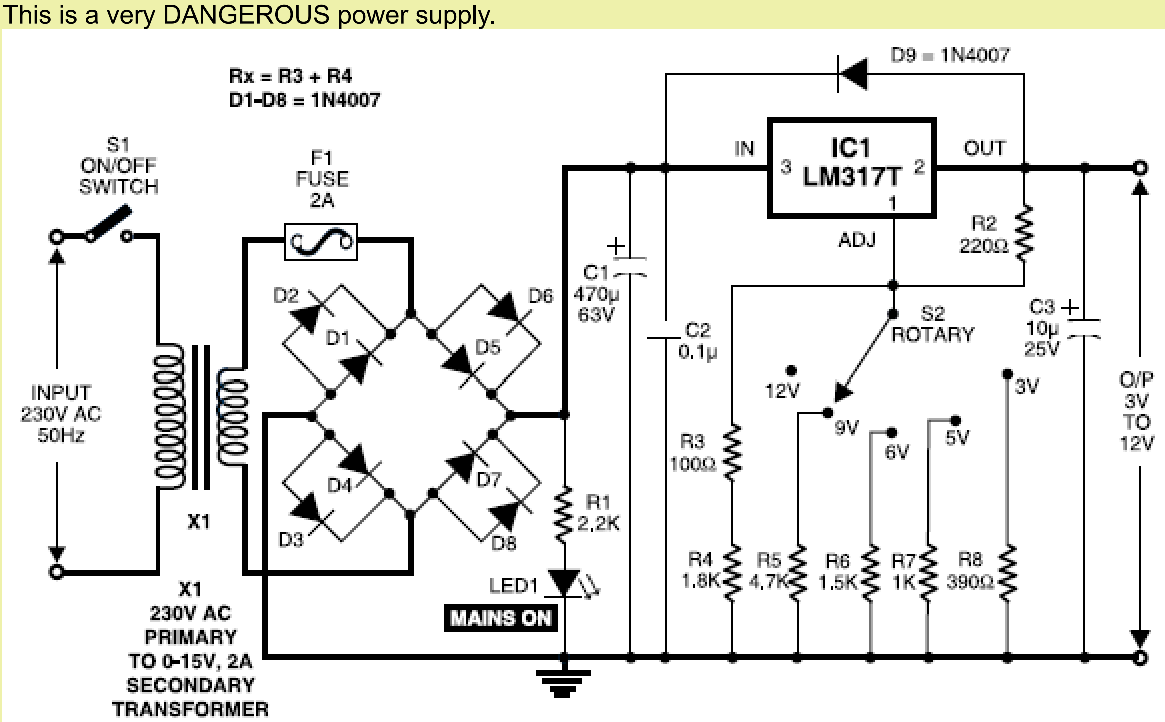
Here are some of the mistakes:

The Piezo Buzzer symbol is the same as a Crystal.

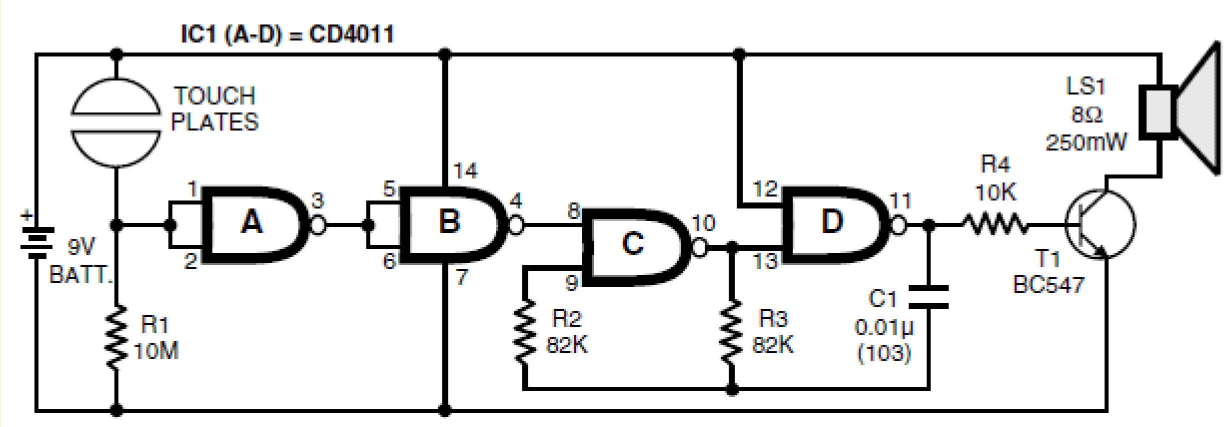


The LEDs should not be shown UP-SIDE-DOWN for a Common Cathode display.

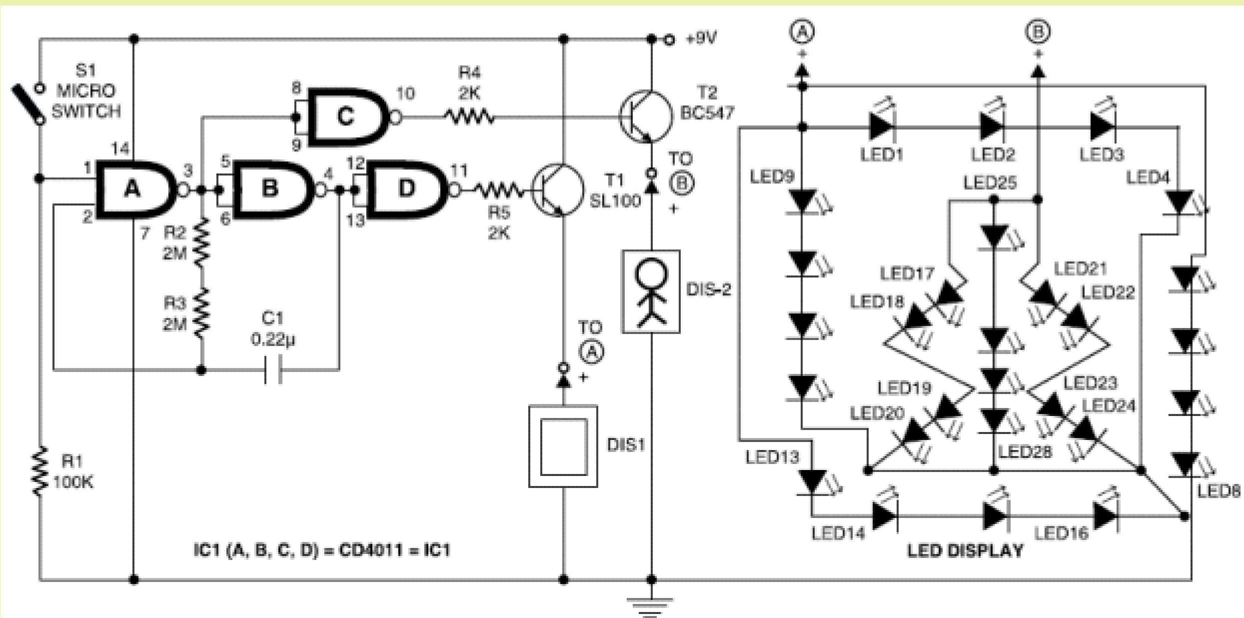
This is a very DANGEROUS power supply.



When the switch is changed from 3v to 5v, the output will instantly rise to 12v during the switching action and blow up the 5v circuit.



8R speaker on a 9v supply will take 1 amp!
If the speaker is being access via a square-wave of 50%, the current will be 500mA. The BC547 can only handle 100mA.



The circuit has 4 red LEDs in series. This produces a characteristic voltage drop of 4 x 1.7v = 6.8v
The circuit also has 4 x green LEDs in series. Each green LED requires a voltage of 2.1v = 8.4v.
But the circuit only has 6.8v across A and B. The green LEDs will not illuminate.
Another circuit that has not been tested.

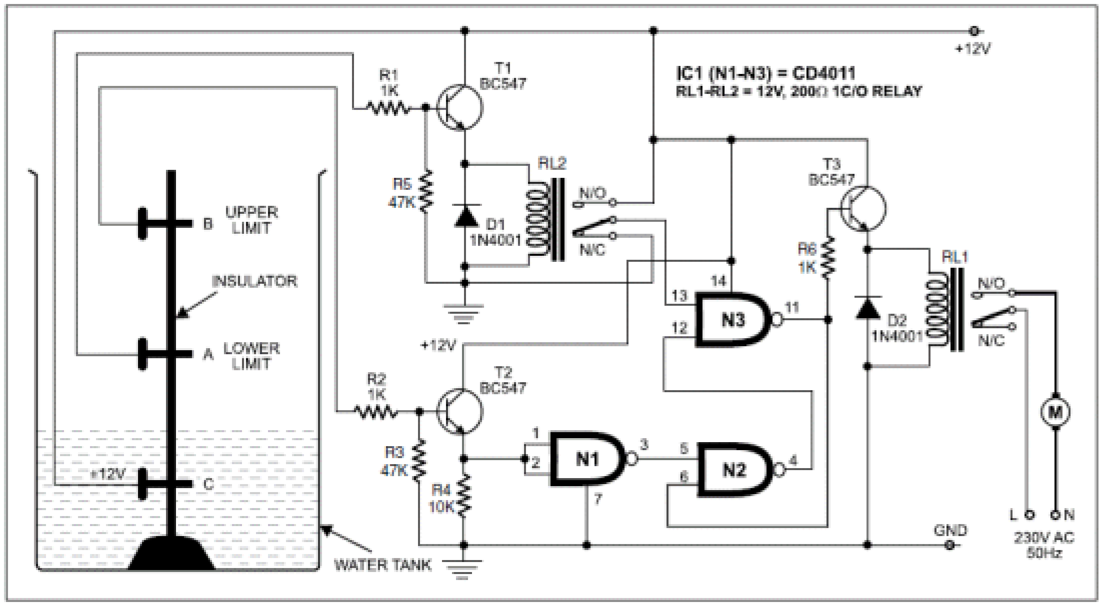


Fig. 2.16: Automatic water pump controller circuit

Why use a relay for a simple job of making Pin 13 HIGH or LOW?
Just another BAD design.

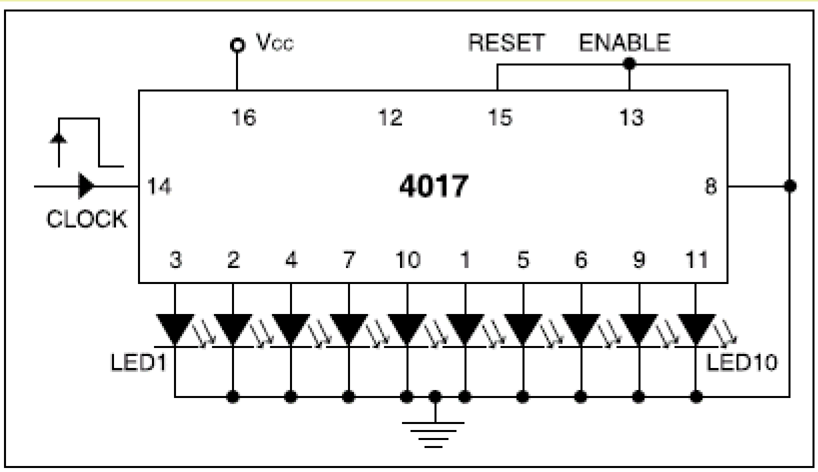
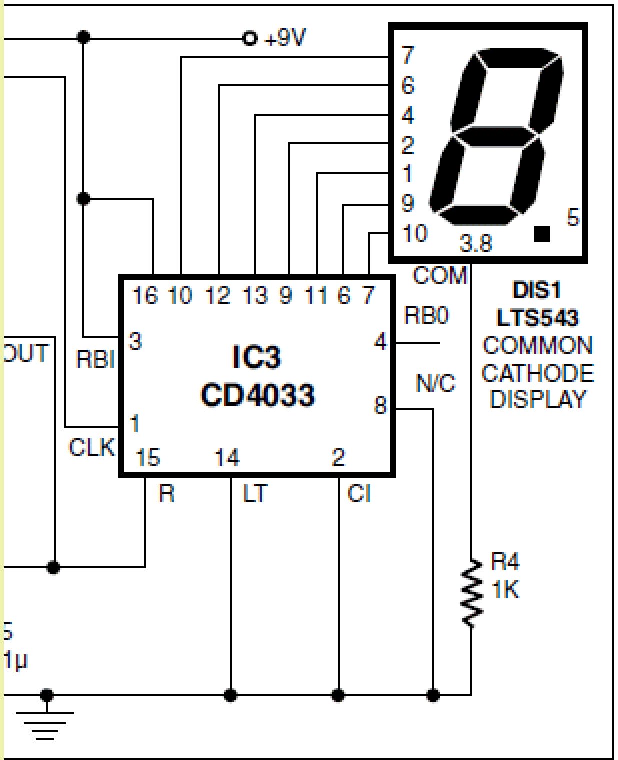
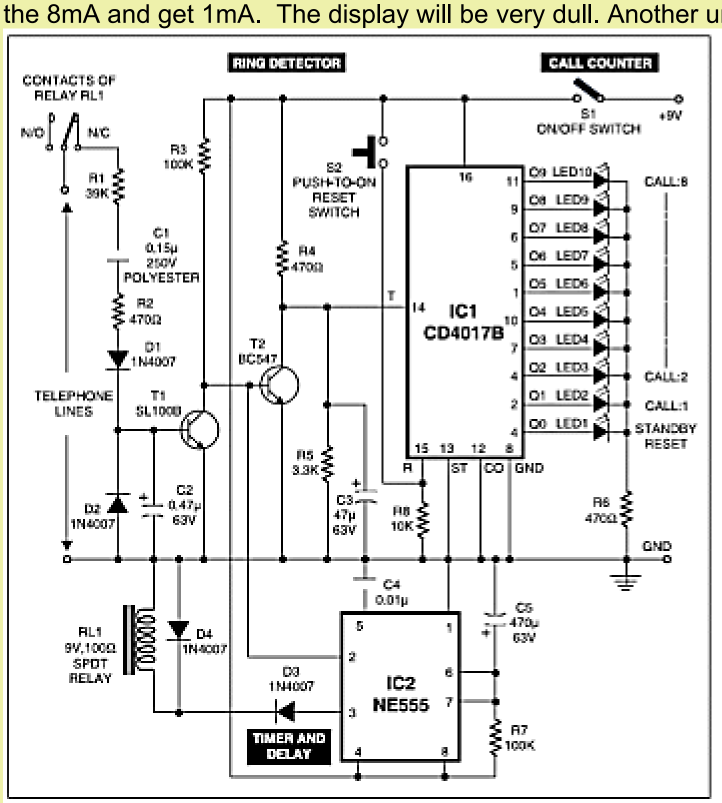


Fig. 3.6: Sequential LED lights using CD4017

You need a single 470R current-limiting resistor on the cathodes to limit the current to 10mA.



A single 1k resistor on the common-line of the 7-segment display is a BAD idea. Each segment line should have a 470R resistor.
The 1k resistor will allow a maximum of 7mA and when the figure "8" is showing, each segment will have to share the 8mA and get 1mA. The display will be very dull. Another untried project.



The voltage on pin2 of the 555 has to change between 1/3 rail voltage and 2/3 rail voltage but the base-emitter junction of T2 keeps the pin at about 0.6v. Another BADLY-designed circuit.

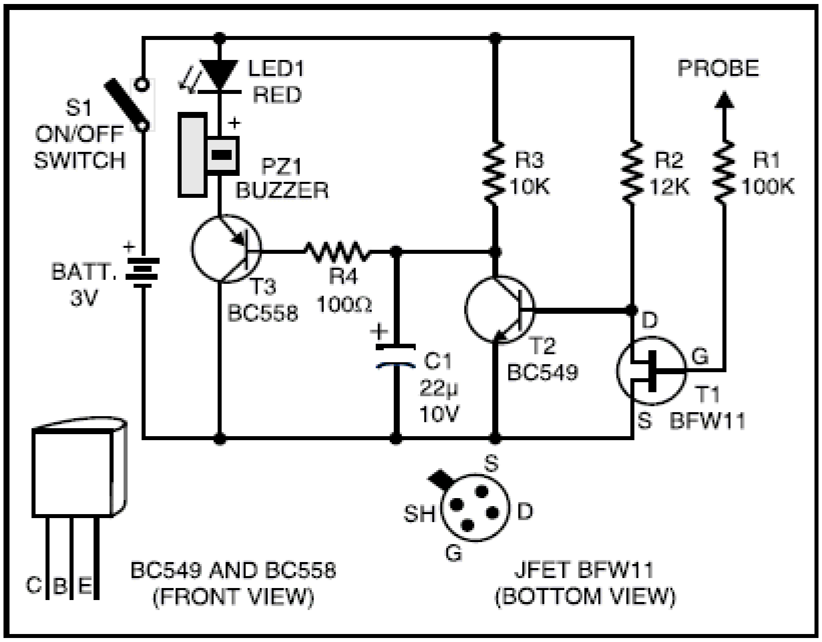


Fig. 4.3: Concealed AC mains line detector circuit

What is the purpose of R4? It can be omitted.

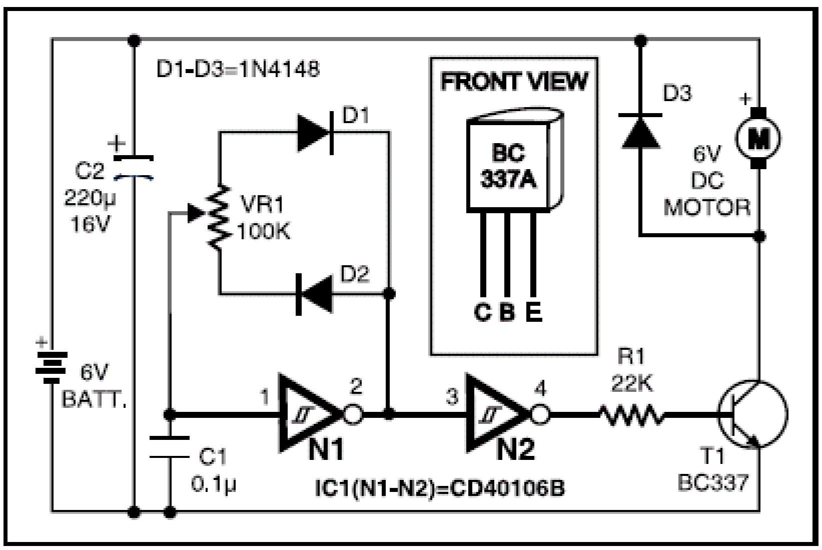


Fig.4.5: Circuit of DC motor speed control using PWM method

A transistor effectively divides the value of the base resistor by the gain of the transistor.
If the gain of the BC337 is 100, the 22k resistor turns the transistor into a 22,000/100 = 220R resistor.
This means it will allow 30mA for the motor.
Working it out another way: 22k will deliver 0.3mA into the base of the transistor. If the transistor has a gain of 200, this will produce a collector current of 60mA. Another BADLY designed circuit that has not been tested.

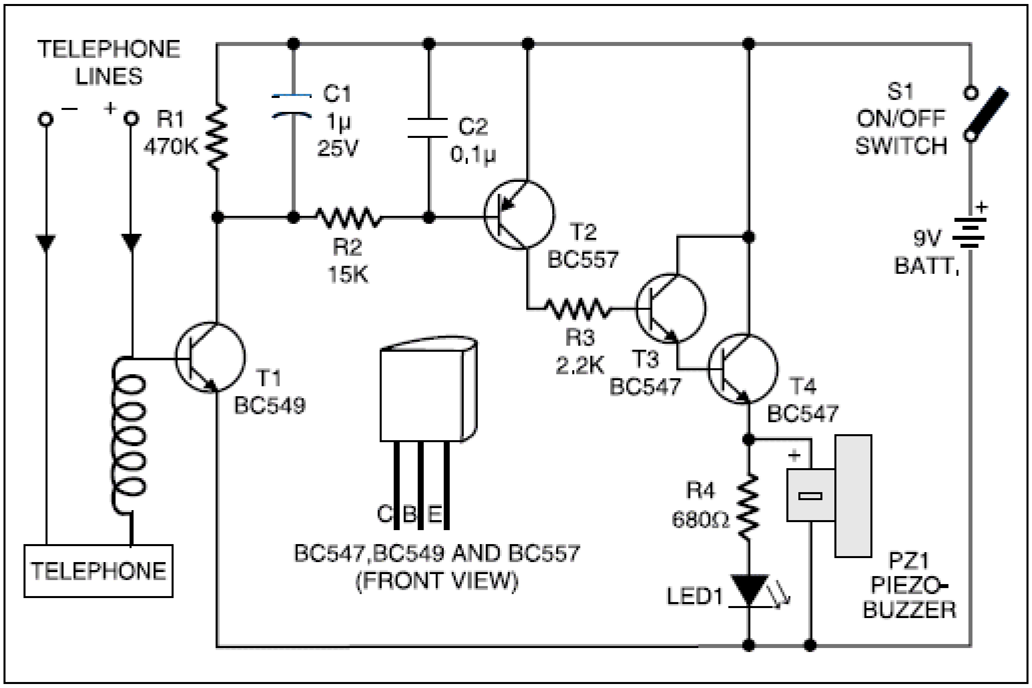


Fig. 4.9: Contactless remote ringer

The coil must be around only one of the telephone wires. The circuit would be much more reliable if the other end of the coil is connected to the emitter as this would deliver a guaranteed voltage to the base.

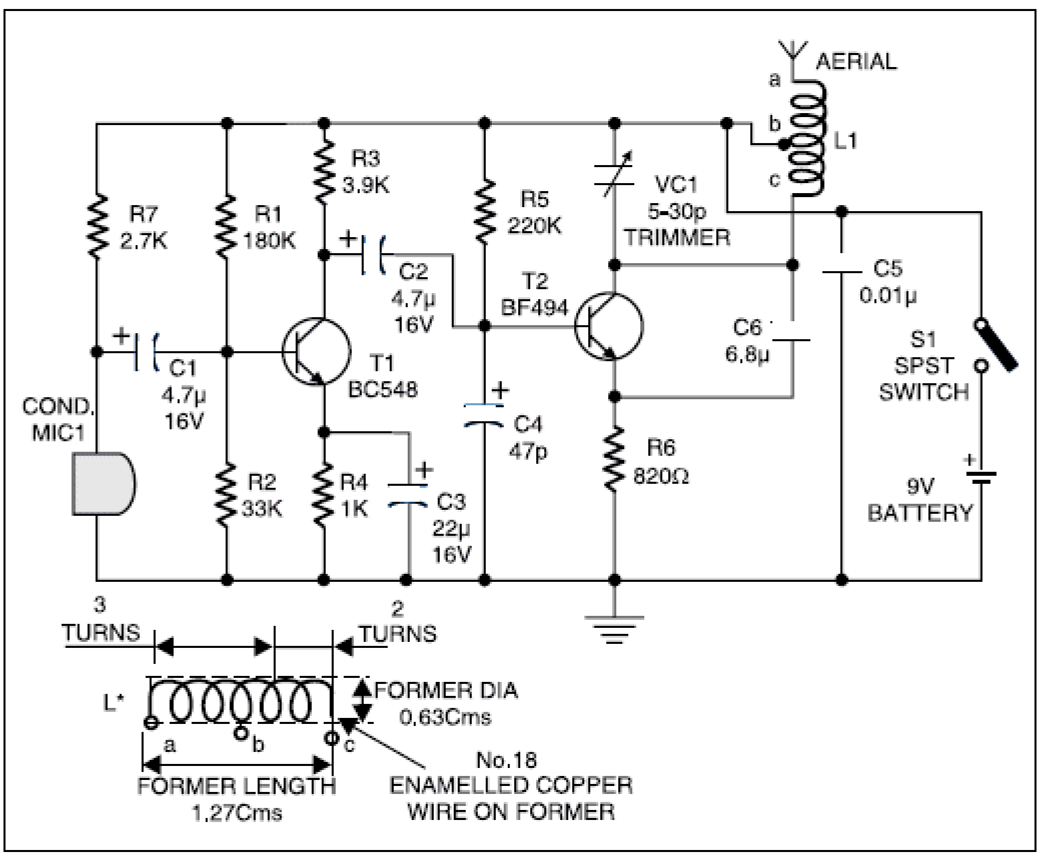


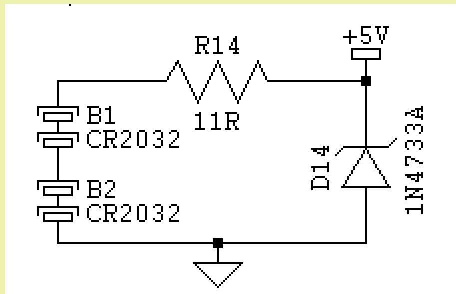
Fig. 4.12: Cordless FM mike circuit

The 2k7 R7 should be 22k to 47k. A low value load resistor will make the microphone too sensitive and produce a lot of "frying" sounds.
4u7 C1 can be 22n to 100n.
47p C4 should be 1n

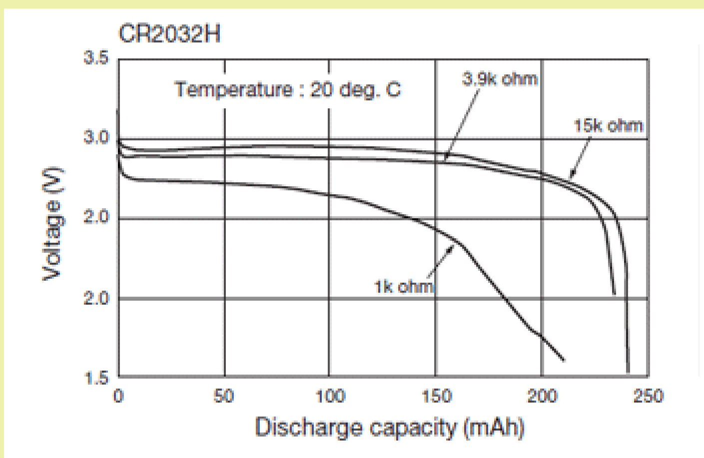
C6 6u8 should be 6p8
The tank coil between B and C should be 5 turns.

BATTERY FAULT

Here is a simple circuit that drops the 6v from the two coin cells to 5v1 via the zener diode:

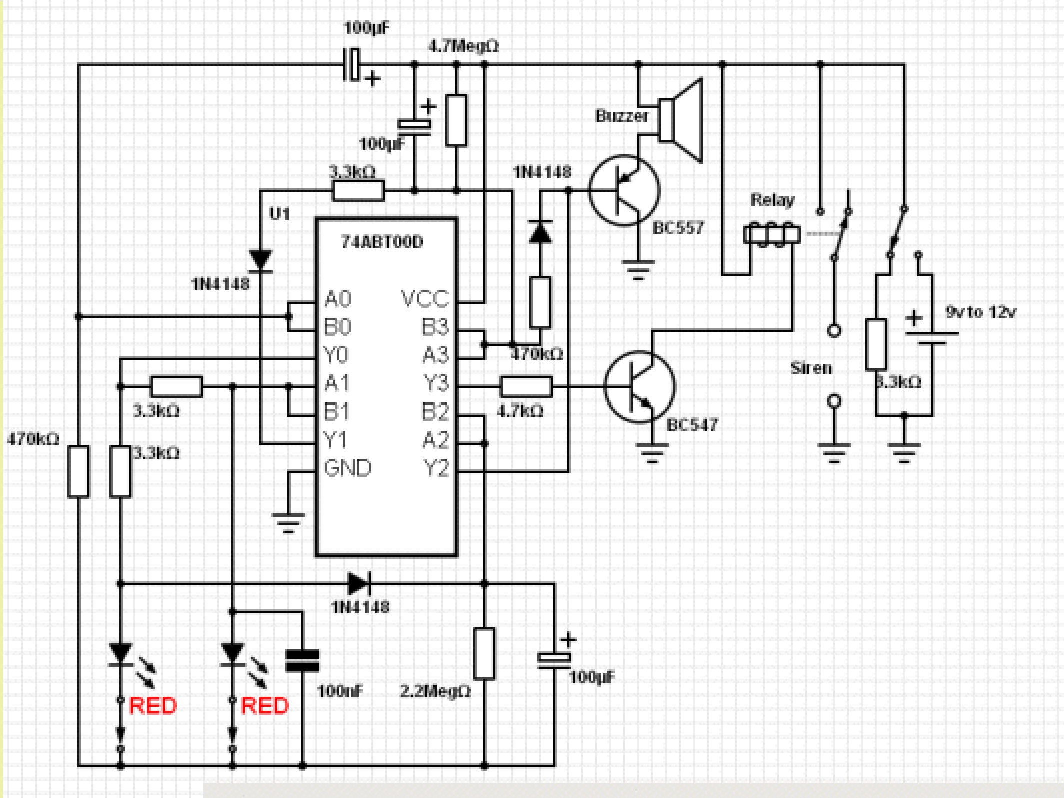


The problem is this:
The zener diode will conduct when the voltage is above 5v1 and current will flow through the 11R because no switch is included.
The current will initially be 6v - 5.1v = 0.9v/11R = 0.08amps. This is 80mA !!!!
The current will continue to flow until the battery voltage is 5.1v and at this point the current will be zero. This means an average current of 40mA will flow.
From the graph you can see the voltage of a coin cell remains very nearly 3v until almost the end of its life.
The 5v1 zener is going to drop the voltage of each cell to 2.55v and about 90% of the energy will have been removed by the time it reaches 2.55v.

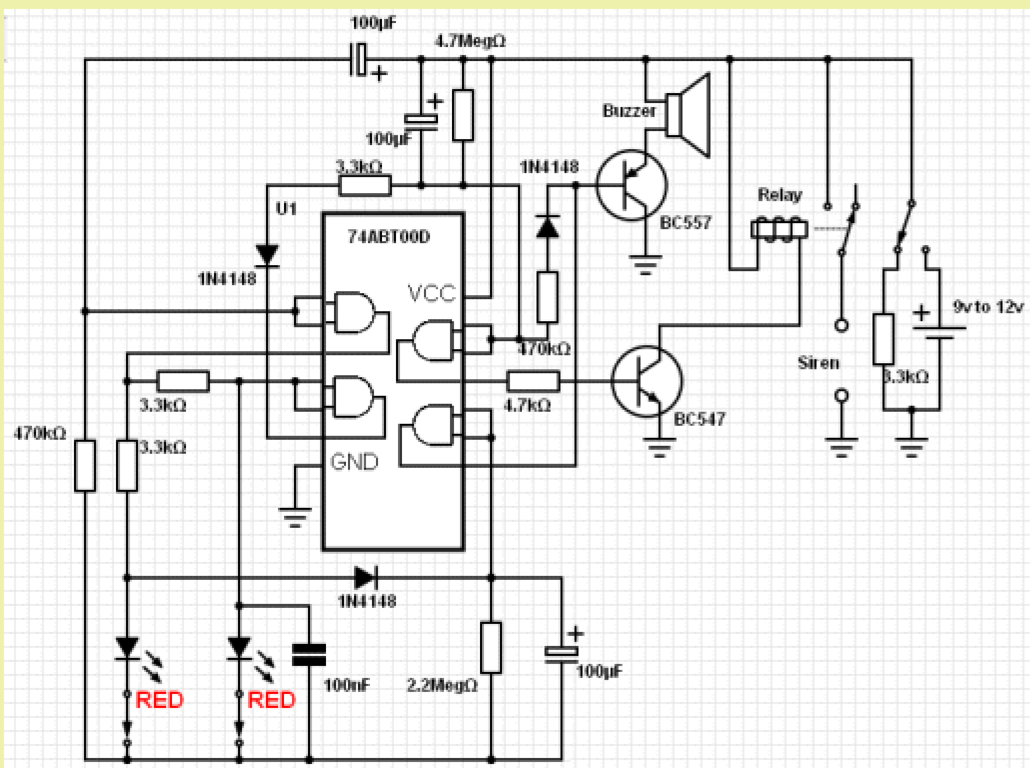


HOUSE ALARM

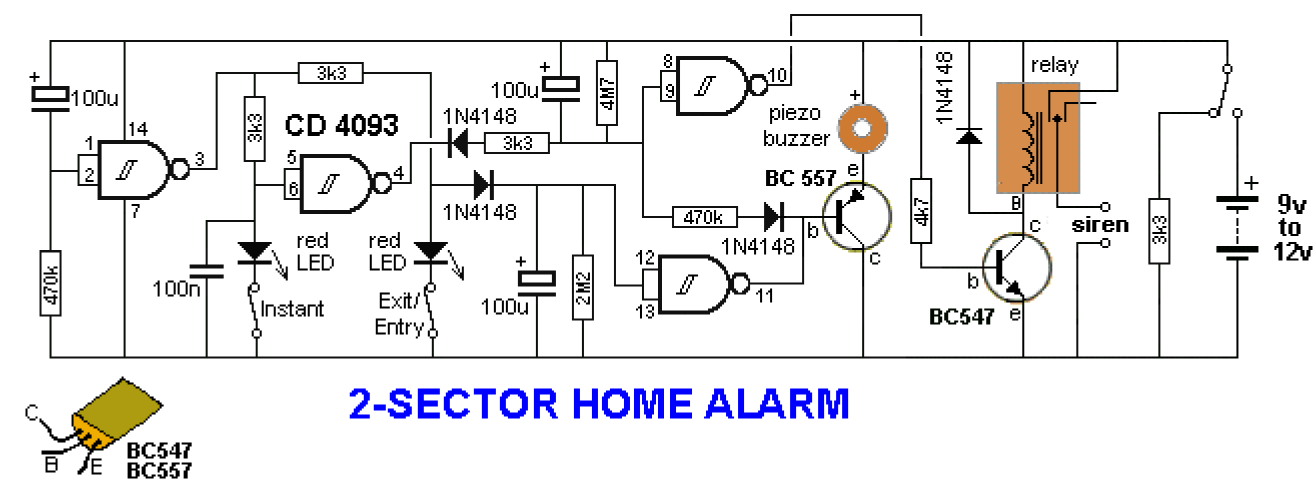
Here's a perfect example, why a circuit diagram should be easy to read.
This circuit was found on the web:



The operation of the circuit was very hard to understand, so the "block diagram" of the IC was converted to gates:



The circuit was then converted to a "linear layout" and it was suddenly realised that the circuit had been copied directly from Talking Electronics website:



I could not follow the original layout AT ALL.
How can you expect a BEGINNER to understand what is happening with the circuit?
It's no winder readers are confused and not learning anything from many of the circuits on the web.
The whole idea of a circuit is to simplify the operation of the project - not make it more complex.
This project can be found in **100 IC CIRCUITS** **as** Alarm **- Home - 2 Sector** and the PC board is available for $3.50

AUTOMATIC LAMP

I have been telling the CEO of **Electronics For You** to stop presenting STUPID circuits from Professor Mohan Kumar. He knows NOTING about electronics and his circuits DO NOT WORK.

Professor Mohan Kumar

Here is another example.

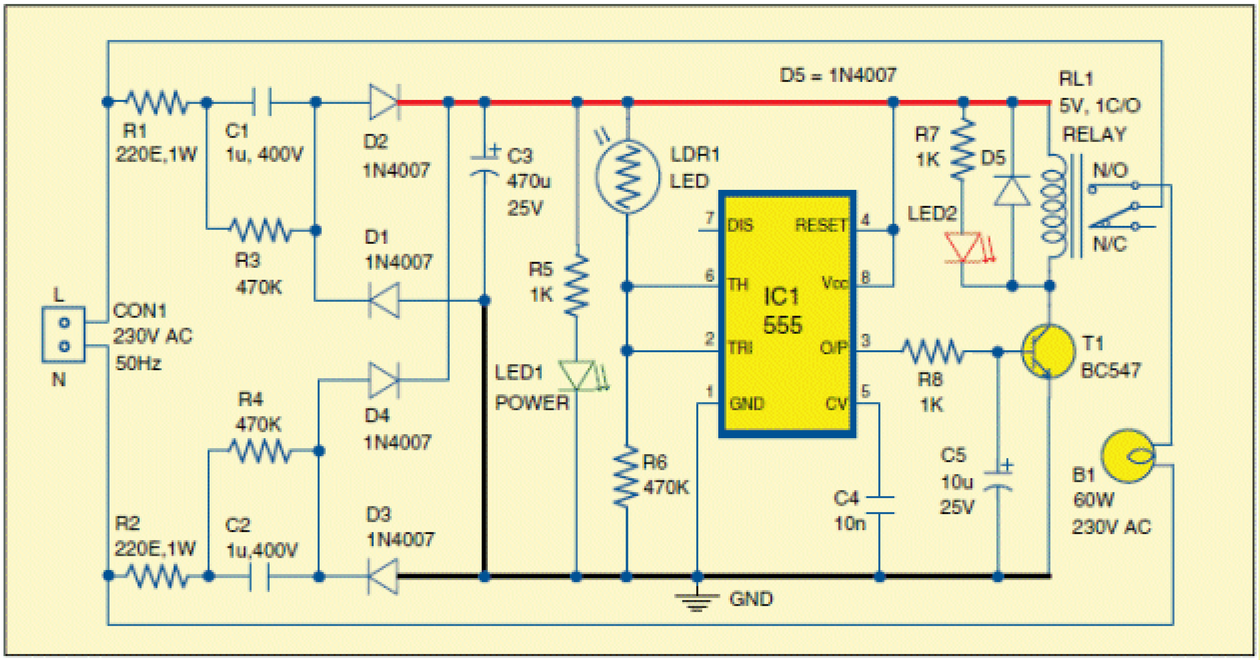


Fig. 2: Circuit diagram of an automatic evening lamp

The circuit is a capacitor-fed power supply and we have covered this type of circuit in full detail in previous discussions.
It is a very difficult circuit to understand and that's why so many designers make mistakes with it.
Basically it is a CONSTANT CURRENT power supply and with two 1u capacitors in the front-end, the resulting capacitance is 0.5u as they are in series.
A 0.5u capacitor in a full-wave set-up will deliver 35mA.
Here's the next fact you have to understand.
The output of a capacitor-fed power supply will be 345v if there is NO LOAD.
When you connect a load, the voltage drops. The final voltage will depend on the resistance of the load.
If the load is 1k, the voltage will be 35v as the current through 1k will be 35mA.
If the load is 500R, the voltage will be 17.5v.
In the circuit above, the load is 1k and a 555. The 555 takes about 10mA, leaving 25mA for the 1k resistor.
This puts about 25v across the resistor.
This voltage will also appear across the 555. But the maximum voltage for a 555 is 18v.
So? What happens.
I don't know.
Maybe the 555 takes more than 10mA when the voltage reaches 18v and everything will operate, but the 555 is being over-driven.
We have now used up all the current from the power supply.
So, what happens when the relay is energised?
I don't know.
I don't know the current taken by the relay.
But there is nothing available from the supply.
So, when the relay is energised, the rail voltage drops and less current flows through the 1k and maybe some comes from the 555. If the relay wants 50mA or 100mA, nothing will work. If the relay needs 25mA, it MAY work.
The whole circuit is just a mess and shows the engineers at EFY don't have a clue about electronics.

Here's a circuit from **ELECTRONICS FOR YOU** December 2014 from a contributor that doesn't know anything about electronics.

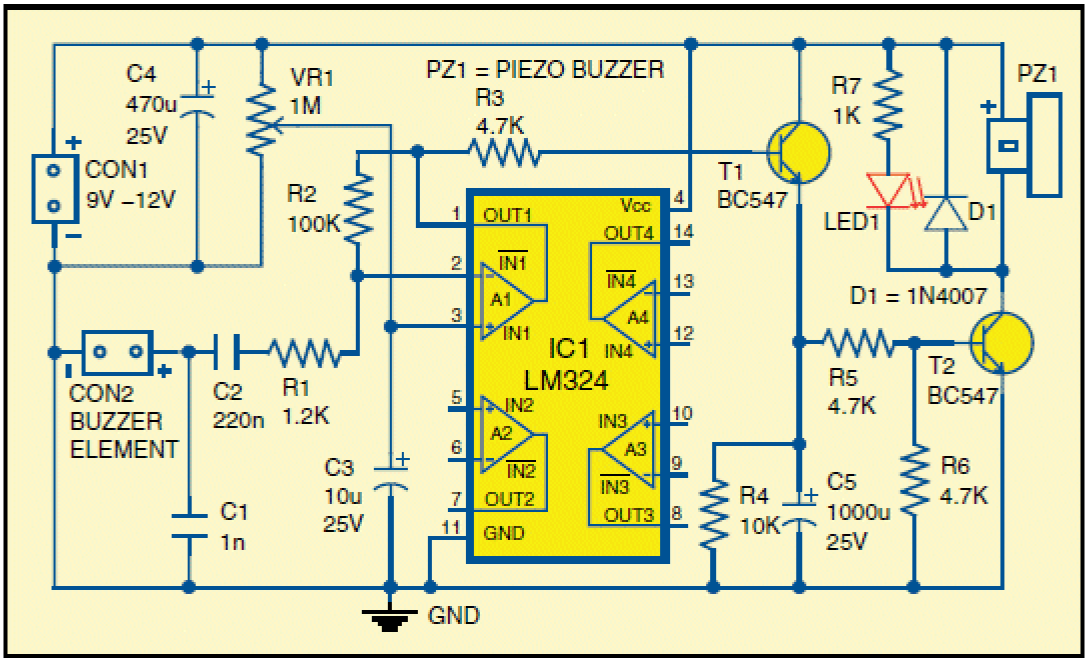


Fig. 1: Circuit diagram of a door-knock alarm

The first mistake is the 220n to the "buzzer element." What is a "buzzer element?" It should read: piezo diaphragm.
A piezo diaphragm is a ceramic capacitor of about 22n, so the 220n is NOT NEEDED.
The 1n is not needed and the 1k2 is not needed.
Next we come to the op-amp.
Only 25% of the chip is being used and this could be done with a simple transistor.
Transistor T1 is an emitter follower and is not needed. The output of the op-amp is capable of delivering a reasonable current.
Next we come to the 1,000u electrolytic.
The same effect could be obtained with 100u across R6.
All these mistakes show a complete lack of understanding of electronics and to put them in a magazine, shows the editors do not know anything about electronics.
I have NEVER seen these types of errors in an Australian, English or USA publication.
It just makes you cringe at the ineptitude of some of the staff at **EFY**.

ELECTRONICS FOR YOU are giving away the magazine for FREE!!!!

A 3-year subscription for 649 INR (about 2-days wage) and you get 8051 Programmer (worth 630 INR).
This is exactly the same competition I faced when trying to introduce Talking Electronics to the USA.
Poptronics offered a 12 month subscription for $19.95 It cost Poptronics $6.00 through the subscription houses and with the $12.00 remaining, it cost 50 cents to post the magazine, 30 cents for the administration and 50 cents for printing. This is $3.60 more than the $12.00 they received!!!!
I then found out they sold 250 magazines per month through the electronics stores. I was tricked into believing they sold 73,000 copies per month.
12 months later they disappeared, leaving the subscribers with NO ANSWER. **Nuts and Volts** offered a free subscription to all those who lost their subscription.
Nuts and Volts has prospered after this offering. They have never looked back. They have now combined with **Elektor** is some form or another, producing two or more different magazines.
All their magazines are very good productions and worth reading.

ALTERNATIVELY:

You can download the full 2014 year of **ELECTRONICS FOR YOU** and see all the mistakes in the projects I have addressed in the last few pages of **SPOT THE MISTAKES**:

http://www.bloglovin.com/frame?post=3835672141&group=0&frame_type=a&context=&context_ids=&blog=3862074&frame=1&click=0&user=0

RRampMeter Application Notes

by Don Fiehmann

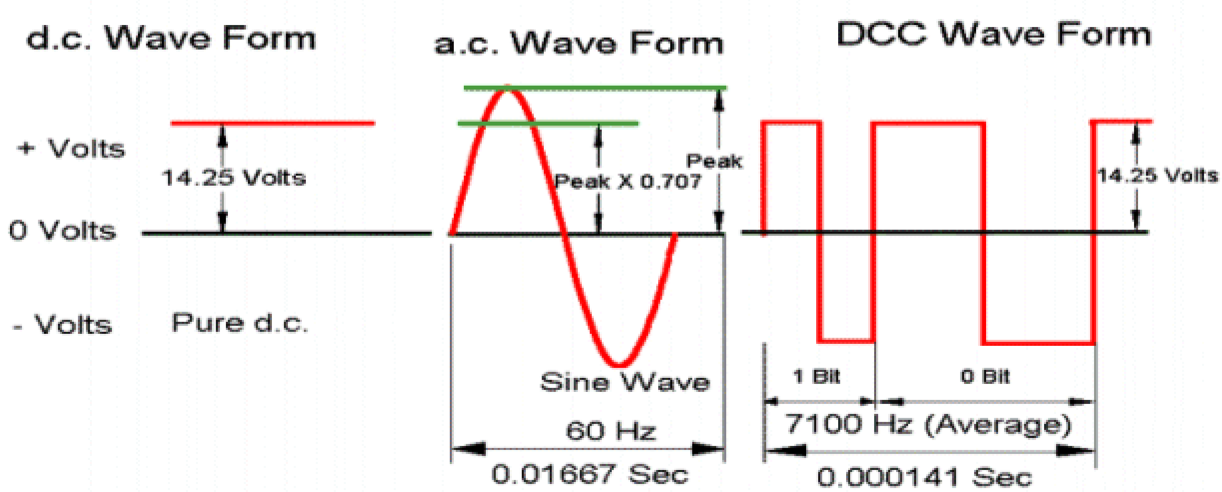
RRampMeter in a case. Battery power meter looks the same, but has a on/off switch below the display.

True "RMS"

Most common meters can read both ac and dc, but can not accurately read DCC power. In order to accurately read DCC power a "true RMS" meter, like the RRampMeter is needed. This is due to the shape and frequency of the DCC signal. The RRampMeter automatically detects and switches to the type of power it is measuring. Two LEDs indicate DCC or ac , no LED on indicates dc.

RMS is an abbreviation for Root Means Squared. It is a mathematical way of analyzing a distorted wave form.

The d.c. wave form is easy to read as it is a steady signal. The a.c. wave form is a relatively



The RRampMeter automatically sense and switches the type of power. Only a "true RMS" meter can accurately measure DCC voltage and current.

slow signal with a higher peak voltage compared to the d.c. signal. Most meters assume a sine wave at 60 Hz and simply take the peak voltage of the wave form and readout a value of 0.707 of the peak. DCC is a different type of signal. The signal is a much higher frequency can vary. In order for the meter to accurately read the DCC value it must compute the value of the voltage to get a true reading.

Don Fiehmann has mixed up truth with fiction.

The area under the graph produces the energy of the waveform. For the sinewave, the lower part of the wave is inverted and placed beside the first half-cycle. You can see the small part of the sinewave above the RMS value fills the space between the two half-waves to produce a rectangle equal to the DC waveform.

For an AC waveform you can consider one of the wires does "not move" and the other wire rises to a high voltage and then falls to the low voltage.

When it comes to the DCC waveform, one wire sits at +14.25v and the other wire is 0v. The positive wire then immediately goes to -14.5v.

There is no gradual rise and fall and thus there is no "area under the graph" that needs to be "computed."

ALL the energy from a DCC waveform is passed to the motor (via a bridge) and thus the energy from DCC is

equivalent to DC.
This means there is no "computing the value of the voltage." It is simply the voltage on the two wires (multiplied by time) and 100% is delivered to the motor (minus the losses in the bridge). That's why trying to introduce the term RMS does NOT apply and this piece of electronic mumbo jumbo by Don Fiehmann needs to be corrected.

Reply from:
Larry Maier
Tech Support
Tony's Train Exchange

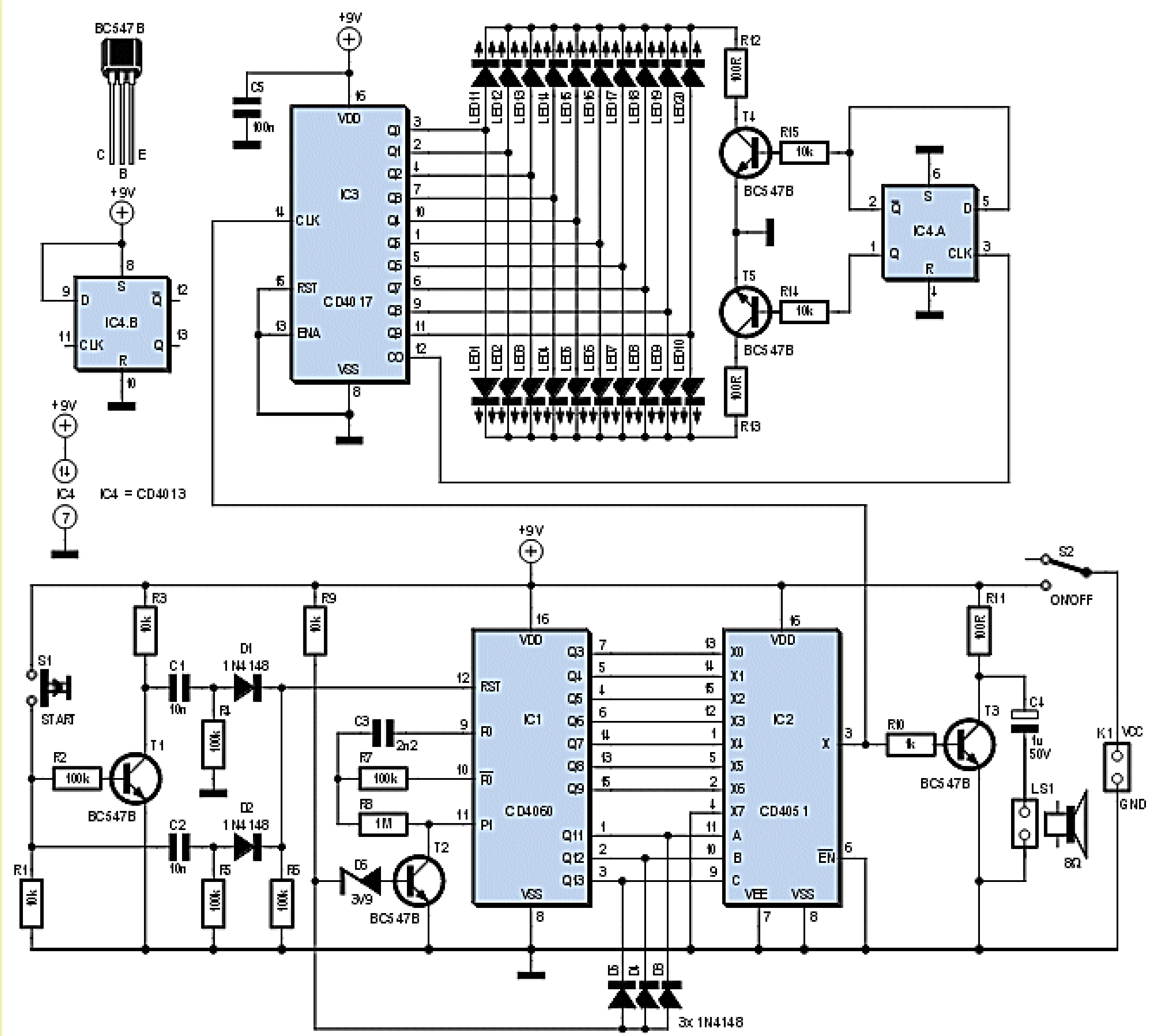
The peak to peak voltage is 28.5 volts, but the RMS value of the shown DCC waveform is 14.25
When the shown DCC waveform is rectified with a full wave rectifier, it produces (approximately) 12.8 volts DC, which is suitable for operating the 12VDC motor found in most engines.

If you perform an RMS operation on a DC voltage, the result is simply the DC voltage. This is a pointless exercise. Introducing RMS tries to make the project more complex than it is. It simply measures the peak voltage and does not consider it to be an AC waveform. Otherwise it will produce a figure of 0.707 x the reading.

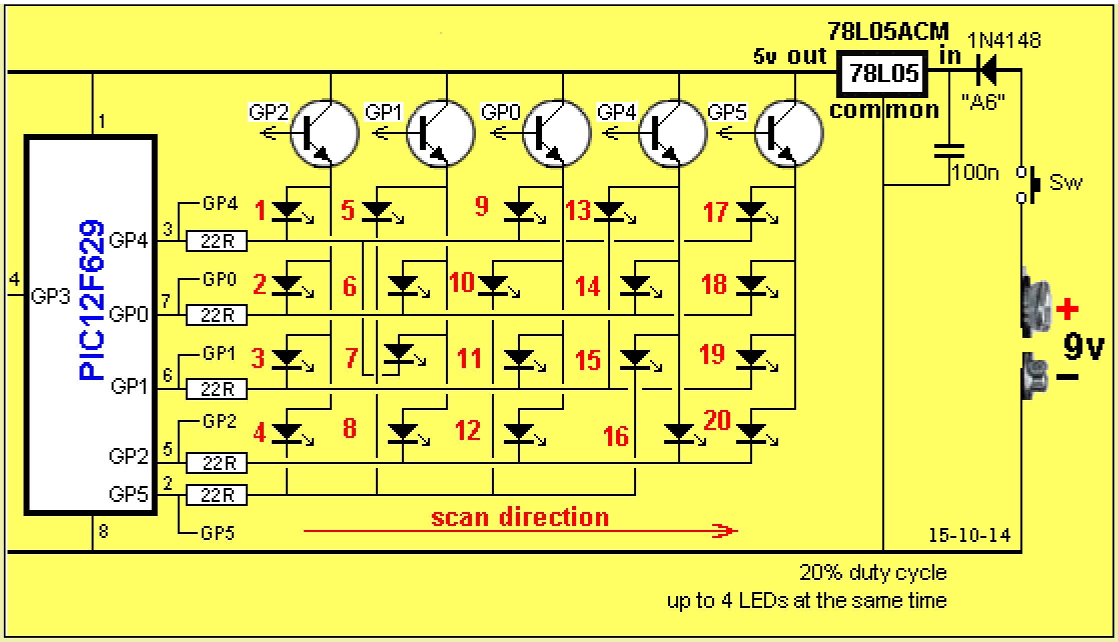
The term RMS was "invented" or started to be introduced when alternating current was first delivered to homes at the beginning of the invention of electricity (electricity to the home).

The original electricity was DC (called DIRECT CURRENT - but actually means DIRECT VOLTAGE) and the voltage (and current) was present at all times when the "electricity" flowed.
When you turned on a 1,000 watt radiator you received 1,000 watts of HEAT. The voltage was 110 volts.
But when AC (alternating current) was introduced, (actually ALTERNATING VOLTAGE) the voltage has to rise higher than 110v because the voltage dropped below 110v for part of the cycle and to "make up" for the drop, the "rise" had to be higher. This means the "peak" had to be about 41% higher to make ALTERNATING VOLTAGE equal to DIRECT VOLTAGE.
Everyone was scared about "electricity" at that time and rather than say the new voltage was "162 volts" they just kept the old voltage of 110v to 120v on all the "stickers" (name plates) and "secretly" increased the peak to 162v.
RMS mean **EQUIVALENT TO DC**.
For DCC the peak voltage is the same as RMS and no calculation or conversion needs to be made.

WHEEL OF FORTUNE



This circuit can be replaced by a single 8-pin microcontroller.
Here is the scan circuit to activate the 20 LEDs. Pin 4 accepts a switch and the output lines are gated to drive a "clicking circuit" to represent the wheel turning.



More mistakes from Electronics For You Magazine January 2015

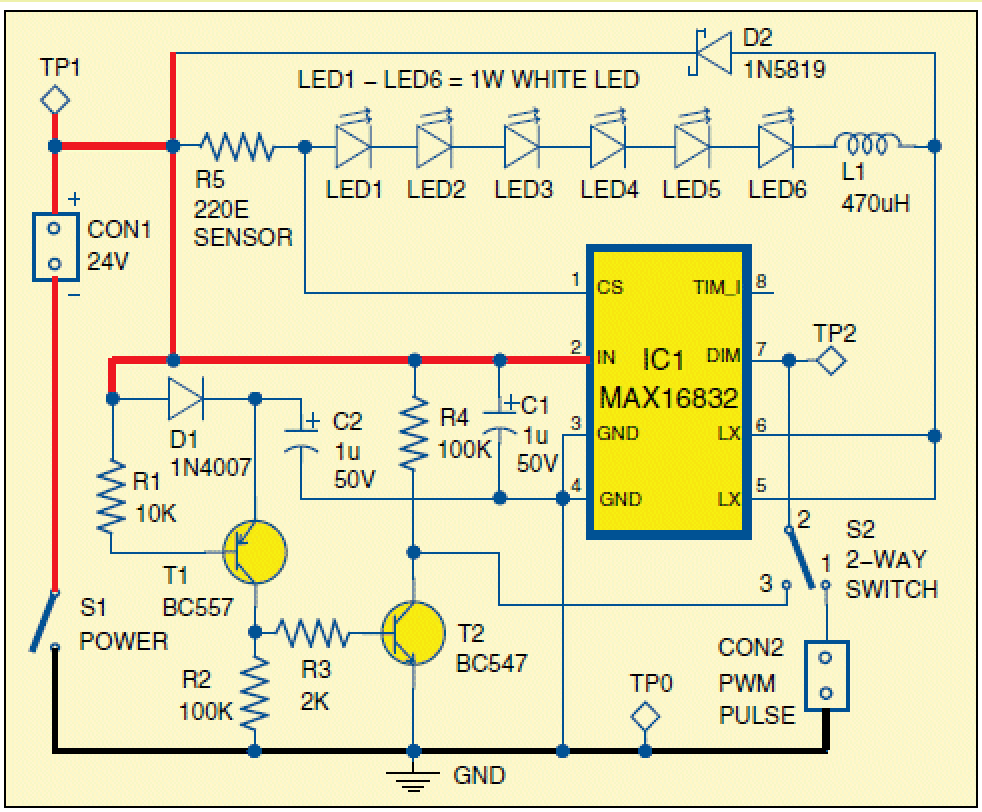


Fig. 1: Circuit diagram of the current-control circuit for an LED lighting system

How are you going to illuminate a 1 watt LED through a 220 ohm resistor????
It should be about 220 milliohm = 0.22ohm = 0.22R = R22 The resistor is one thousand times too large !!!!!!
I saw this fault INSTANTLY. None of the staff at EFY picked up the mistake. It was repeated 6 times in the project !!! How dumb can you be ????

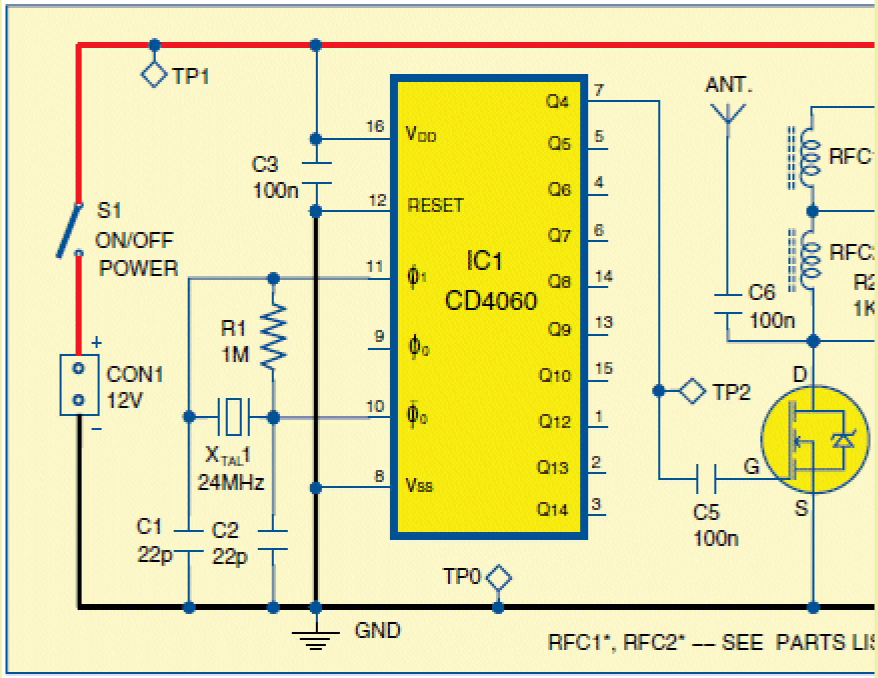


Fig. 1: Circuit diagram of the crystal-locked medium-wave transmitter

A CD4060 will not work at 24MHz. It goes to about 12MHz max.

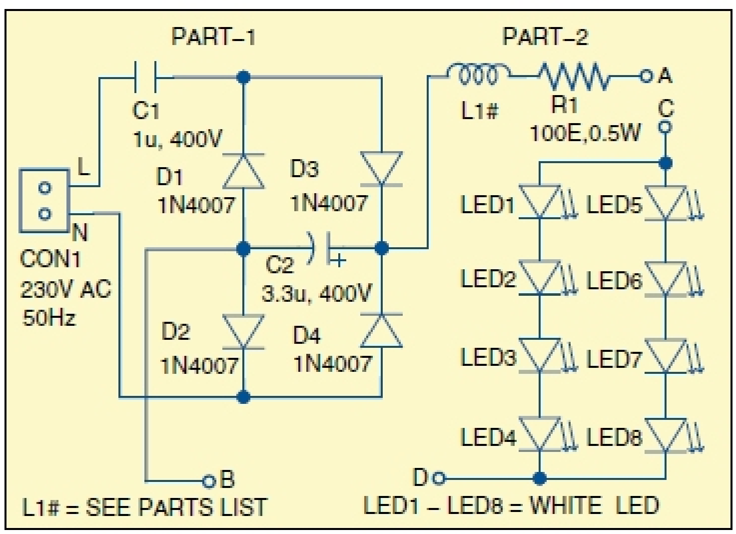


Fig. 1: Circuit diagram of the illuminated optical magnifier

The only problem with this circuit is the current delivered to the LEDs. The 1u capacitor will deliver about 70mA in full-wave and this delivers 35mA to each string of LEDs. A 5mm LED needs 17mA and 25mA max. 35mA will limit its life considerably.

Now we come to projects in Everyday Practical Electronics.

I offered to supply them with beginner projects as I could not find anything in their issues for the past year that was suitable for a beginner and had the back-up of a kit of components.
They reply from Matt Pulzer: We have so many projects awaiting publication at the moment that I am not accepting further submissions for now.
The project he is referring to come from Silicon Chip and are re-presented in the magazine 12 months AFTER they are released in Australia.
These kits were backed up by Jaycar but the response was so poor that Jaycar has pulled their entire advertising over 12 months ago.
I then contacted all the advertisers in EPE to see if they were interested in supplying kits. The response surprised me. None were even the slightest bit interested and one said the projects were "boring old amplifier that no-one

wanted to build. He had already contacts the editor with suggestions and the email "fell on deaf ears."
I have to say I have never read EPE but the past issues had lots of beginner projects. As soon as Silicon Chip took over, these projects disappeared.
I contacted Silicon Chip with a small project and the reply from Leo Simpson was::

I am afraid your intruder alarm would not get to first base. Put simply, the PCB is not big enough to accommodate all the components - the battery holder is only half on the PCB. Nor are there any mounting holes for the PCB. There is not enough supply bypassing with only 10uF & 100nF capacitors and there does not appear to be any input protection for the micro.

I thought Leo Simpson had some understanding of electronics. But to say the PCB is not large enough is absolutely absurd. The battery holder is a 3v coin cell holder and it has two very strong pins. It does not have to be fully mounted on the PC board. He could have said: "could we make the PCB longer" . . . . . .
If you look at their PCB's and the cost of many at $10.00 it is no-wonder they sell 1 to 5 boards over a period of 18 months. Their projects are simply not popular because the board is too expensive and no-one provides a back-up kit.

You don't need mounting holes for a small board that is going to be placed on a shelf with the PIR detector.
Then he really caps it off with his understanding of electronics when he says:
There is not enough supply bypassing with only 10uF & 100nF capacitors and there does not appear to be any input protection for the micro.

The **Intruder Alarm** project takes 1.5mA 10u electrolytic is ample for 1.5mA and 100n is across the chip.
Then when he says there is no input protection - - - - - I ask him: " where do you put the input protection?????
He complains about my small PC boards but have a look at this board for $15.00 Australian or about $30.00 UK.
Not only is the board twice the size it should be but it has no legend.

Here's another example of a board without any component markings. Imagine how difficult it will be to place the components correctly when you have a bare board filled with holes.
I was one of the first magazines in the world to provide PC boards on the front of the magazine with component identification.
I still have a box of boards from EPE's previous magazine, Everyday Electronics, without overlays and it is almost impossible to build them. They don't even have a name on the board !!!

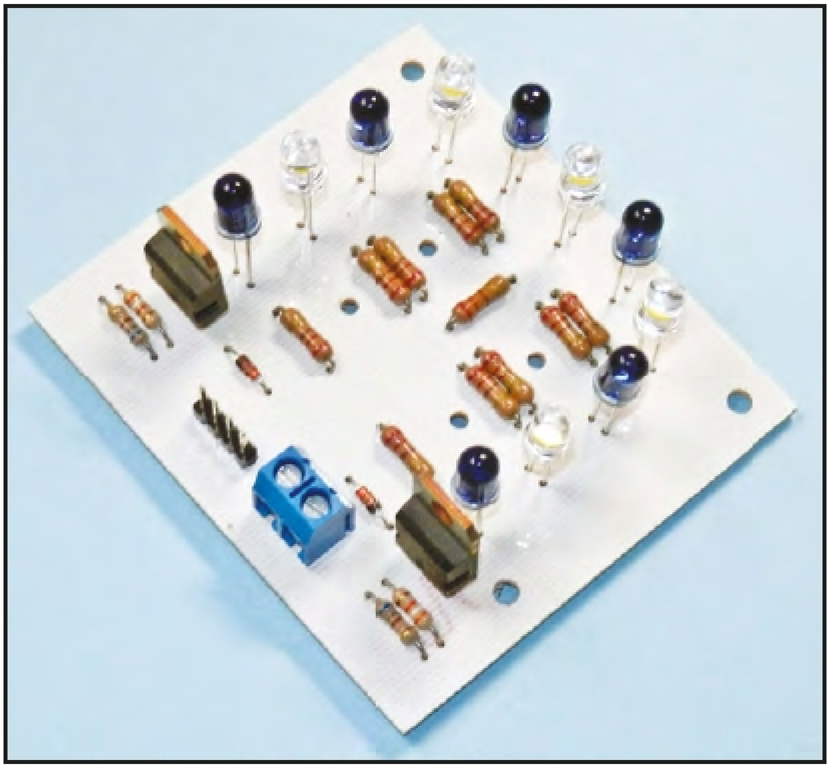
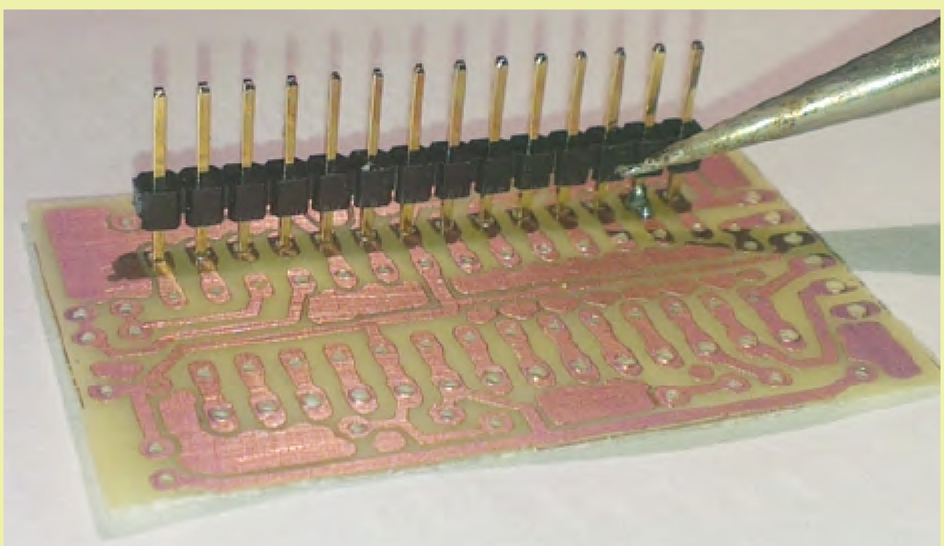


Fig.9.8. Completed PCB ready for the NoIR camera module

Here's another poor quality presentation. The board has obviously been hand etched and doesn't have a solder mask or tinned lands.
I would not put this piece of rubbish in a magazine as an example of how to build an electronic project. A board like this would cost less than $3.00 to get professionally made and avoid the embarrassment of someone criticizing it.



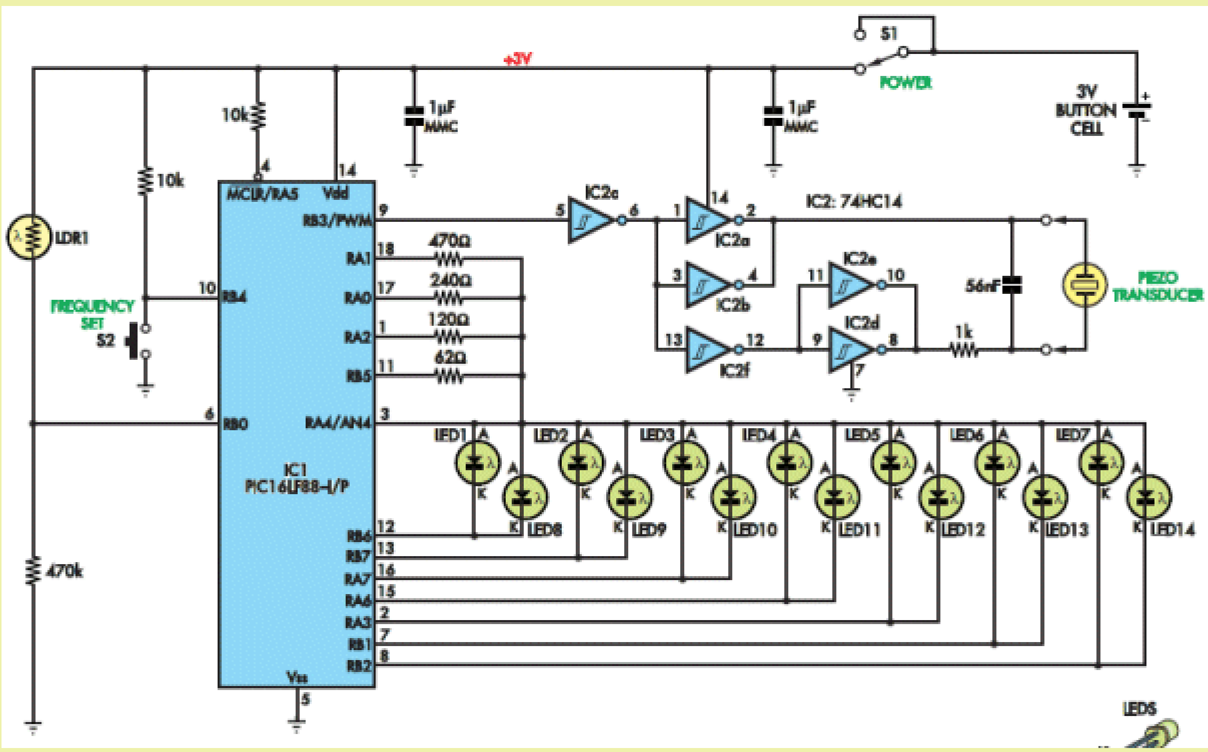
What a piece of junk !

Now we come to a technical mistake in **LED Lady Bird**.
I have provided my comments in blue. The project uses a PIC micro, a 3v lithium cell and a number of LEDs without any current-limiting resistors.

LEDs1-22 are driven directly by IC1's output ports, without current-limiting resistors. This was done both to save on the parts count and because there's no space for current-limiting resistors on the PCB.
Driving the LEDs in this way is quite acceptable provided we don't cause too much current to flow in the output pins.
In this circuit, the maximum supply voltage is around 3.3V (with fresh cells) and this prevents each output from sinking more than about 21mA. **This is NOT TRUE.**
This is within the limits allowed for both the microcontroller's output pins and for the LEDs.

How do we arrive at that figure? Well, the impedance of the output pins is typically 70 ohms and there will be 1.8V across each LED when it is on. This means that, with a 3.3V supply, the voltage across the 70ohm output impedance will be 1.5V, so the current through the LEDs will be 1.5V ÷ 70 = 21mA.
This is NOT the way to work out the maximum WATTAGE allowable for each output.
The maximum allowable current for each output is 21 to 25mA but this is assuming the output FET is FULLY TURNED ON. When it is fully turned on, the voltage across the FET is only about 50mV to 100mV.
This gives a wattage or milliwatt rating for each output.
But when a LED is connected directly between an output pin and the supply rail, the LED produces a characteristic voltage across it of 1.7v for a red LED and the remaining voltage appears across the FET on the output of the micro.
In this project there is a fully turned ON transistor in the drive-line and the battery voltage can fluctuate from 3.3v down to 2.5v.
However if say 3.3v - 0.2v across the transistor - 1.7v across the LED = 1.4v across the FET. This is considerably more than the normal 100mV and the FET will try to dissipate up to 10 times more than its specification.
This is just a point that the author John Clarke is not aware of.

BELLBIRD



BELLBIRD CIRCUIT

There are a number of technical mistakes in the circuit. Here they are:

The 74C14 IC is used to provide reversal on the output to deliver 5v to 6v to the piezo.
But when the chip is supplied with 3v, the outputs of this IC will deliver very little current. The output of a micro is about 20mA to 25mA over the full range of supply voltage, but the 74C14 has problems at 3v. This means the output voltage will not be rail-to-rail. The chip could be wired to deliver 3 outputs plus 3 outputs, rather than wasting 2 gates.
The 1k in series with the piezo diaphragm reduces the output because the piezo is effectively equal to about 20n and this makes it about 2,500 ohms at 2800Hz and when combined with 56n, the voltage is divided (reduced) to less than 40%. The piezo can be connected directly to the output of the micro and the volume will be the same or louder than the circuit above. Switching (reversing) the voltage makes very little difference to the output volume with such small voltages.
It is difficult to see the reason why the LEDs are connected to all the different value resistors when any effects can be produced by pulsed operation from the micro.
1u monoblocks are not needed. 100n is sufficient.
Just an overdesigned circuit. I don't like the arrows on the leads of the piezo, it infers the piezo is providing a waveform **to** the circuit, whereas it is receiving a waveform. The LEDs in parallel will get very little current from a 3v supply. The text says the circuit takes 1.5mA when operating. 0.75mA is not very much for a LED. 470k on the

LDR means the LDR must go to about 1M to reduce the voltage on the pin to create a LOW. Most of the small LDR's go to about 750k and pin 6 may not see a LOW. The resistor should be about 220k for reliable turn-off. This whole circuit could be done with an 8-pin chip, rather than wasting an 18 pin chip.

Here is a "cry in the wilderness:"

Dear editor

I received a subscription to *EPE* as a Christmas present this year and have enjoyed most of the articles presented in it. However, there is a problem associated with some of the constructional projects. Most seem to be reprints from *Silicon Chip* magazine, which I believe is produced in Australia; possibly why the components and kits seem easier to source there.

I have tried to get the components in the UK, but this has not been easy as you need to go to a number of suppliers to get all of the items and in some cases there are many options for the same IC, which perhaps needs a more detailed specification in the list of components. An example is the LMC6482 dual op amp. The Element14 site gives many variations/options for this chip.

I am aware that you cannot recommend suppliers and you state 'We do not supply electronic components or kits for building the projects featured, these can be supplied by advertisers'; however, do you check they are actually available from your advertisers?

I am fairly new to building your projects, but feel that the component supply problems mean that it is unlikely I will be able to complete any of them without spending a considerable amount of time contacting the suppliers.

Perhaps you might consider encouraging UK-based suppliers to produce 'complete kits' for your projects. It would make life so much simpler for your readers.

Glenn Jones, via email

Matt Pulzer replies:

Glenn, congratulations on your Christmas present and welcome to EPE*!*

Yes, we have an arrangement with Silicon Chip *magazine whereby we use the best of their projects.*

Yes, we do check that kits are available, but as with all things, supply levels can fluctuate. In fact, we go to some trouble to make sure that components are available – either as kits or standalone components. Generally speaking, it is best to buy a kit whenever possible and with the globalisation of the economy, p&p from Australia usually adds surprisingly little to the overall cost of a project and delivery is within a week – see: **www.jaycar.co.uk**

If you have a particular problem in locating or choosing a component then I strongly advise you to visit our Chat Zone *forum:* **www.chatzones.co.uk** *– it is a friendly place, with people always ready to help and answer questions, however basic or simple, so don't be shy!*

I do understand that buying components individually can seem daunting at first. Usually, the cheaper version is the right one for our projects. If you need a more exotic version then we will usually spell that out in the text. For semiconductors, do make sure you get the

correct casing for a device. Keep an eye on our regular column Practically Speaking, *which often addresses component selection.*

Go to the chat room. Apart from the difficulty in getting a password to enter, the Forum sees less than 10 visitors a day. How can you get a response when almost no-one is visiting the Forum???
Why doesn't EPE provide a list of suppliers who will provide a kit for the project. Why? Because NO-ONE is interested in providing kits that DO NOT SELL.
Jaycar pulled their advertising over 12 months ago because the response was ZERO.
The Projects are simply NOT popular. This is proof as the sales from Silicon Chip site show 1 to 5 PC boards in a period of 18 months. EPE are getting the boards made on a '"one-off" basis, when you order. What a "hand-to-mouth" existence.
Both **Silicon Chip** and **Everyday Practical Electronics** are living their last days.
Sales have plummeted from a circulation of 73,000 (this means a readership of 73,000 and sold copies of 43,00 - another impressive STUNT from most magazines) to 35,000 "sales" (whatever sales means) to 10,000 (and less) actual sold copies in just 20 years. The reason is the internet has taken over with hobbyists going to **You Tube, Make** and **Instructables**.
A magazine is not viable under 15,000 when you think of the cost that goes into its production and printing and the dwindling return from advertising.
EPE has only remained afloat by re-releasing old material that does not cost them anything, compared with generating new designs. And you can see by their Alexia website global traffic rating of 3,044,165 it is not in the run for any award. Talking Electronics is 179,864 and it gets 6,000 visitors each day. This is a 16:1 ratio and EPE has had a visual representation in the market for over 25 years. This is an appalling indictment of how NOT to presents electronics to the hobbyist and enthusiast.
Alan Winstanley of EPE has some "Mickey Mouse" **Soldering Guide** that he wants beginners to pay $9.00 to

$18.00 for a Kindle version or paper-format.

Thus is a terrible guide. Look on Amazon for a preview to see how much unnecessary information (verbiage) is presented. It is out of date, (he talks about a temperature-controlled iron for $80.00 whereas they are now $10.00) out of touch with reality (does not talk about copper-wire sponge and lots of other things) and I have produced a FREE guide to soldering containing all the points missed out by all these "guides." They are just mountains of verbiage.
You have to provide something worthwhile on a website to get visitors coming back again and again and the internet is the way of the future. The two magazines have nothing. They just want to squeeze "the last drop of blood" out of a dwindling audience and try to charge for every minute item.

Even on the internet, the conversion-rate can be as high as 50,000:1. In other words it needs 50,000 views of a project to get one order or one person constructing. With sales of 10,000 for a publication, you can hardly get one sale for each page of advertising.
Things have changed over the past 20 years. Conversion rates were 1% to 5%. Not now. The reader has such a wide variety of options and choices. And of course computer games, Facebook and Apps?? have taken over.
You Tube projects, **Make** projects or **Instructables** are getting 50,000 views. Compare that to 10,000 sales of a magazine. Magazines are DEAD.
Anyone who does not see the "writing on the wall" for the print media is burring their head in the sand and simply "re-arranging the deck-chairs on the Titanic." The only publication to increase its sales this year is Charlie Hebdo. All the rest are on their "last legs."

It's a sad situation but magazines are not providing any instructional videos to back-up their project. They don't offer any kits and have stupid prices for PC boards. They do nothing in their favour.
The Chinese produce boards at 10% the price of all other manufacturers. Magazines have NEVER offered this and

NEVER passed on the lower prices. The same with kits.
The Chinese offer kits with free postage for 10% of the cost of magazine kits.
Readers are starting to become aware of this and eBay has taken over as the largest sales of electronics components. Electronics suppliers are nearly doomed too. It just takes time to see them go. You can buy ANYTHING on eBay.
You can fool some of the people some of the time but not all the people all the time.

LET'S GO BACK

I didn't want to start a magazine in the first place.
I knew it was impossible to design projects, write them up in "publisher format", draw the circuits, take photos, layout the pages, pay for printing and handle the advertisers.
So about 1980 I sent a letter to **Electronics Australia** with a suggestion to the Technical Editor Jim Rowe that I would supply some beginners projects. At the time they had one or projects in each issue and I thought to add to this with a larger range of projects.
He accepted my offer. On the second page of his typewritten reply, he said, Oh, by the way, if you fail to deliver the projects by about 23rd of the month, there is a penalty of $2,400.

That is equal to $20,000 today. I bought my first block of land for $2,000 - so the "fine" was ENORMOUS.
That spurred me to produce the magazine myself. For $2,400 I could get 10,000 copies printed at our local web printer.
From the first day the magazine hit the newsagents I got 80 orders. And I never looked back. The first issue was 32 pages and typed on an electric "Golf Ball" typewriter.
After about a year of running **Jim Rowe** had the audacity to come to my office with Virginia Salmon (the advertising manager) and say "I suppose you didn't like the penalty in the letter I wrote to you."

What could I say? with 8 staff around me and a woman. I said nothing.

But that's how the opposition tried to stifle me.

But it didn't end there.
After 2 months of operation **Electronics Today International** sent all their advertising representatives to the advertisers offering 12 months advertising for half price.
I could not get one single advertiser (components supplies) and decided to continue with the magazine WITH NO ADVERTISING.
But that wasn't enough.
The opposition magazine then decided to put out a competition magazine for 95 cents, whereas mine was $1.25.
They continued for 6 months, putting out up to 40,000 copies each month.
Then, one day Colin Rivers rang me to say: "You have won the day."
I didn't know what he meant, so he explained that they were pulling "Hobby Electronics" because I had not folded. It had cost them $50,000.
In the meantime I had learnt from an advertiser that the other magazine was scrutinizing my publication for a single paragraph that could constitute "copywrite infringement" . . . for an all-out court case.
Luckily I never read any of their magazines and nothing of mine even resembled any of their articles.
Now we come to Silicon Chip.
I offered to supply articles to them just recently, but obviously the success of my magazine was still in the mouth of Leo Simpson who realised my approach to writing (and content) outshone their endeavours and he gave some poultry excuse for not wanting to include them.
Obviously EPE could not include them because they had sacked all their production team. They are the losers.
With a circulation of 10,000 the number of beginners will be miniscule as not one single beginners project has been presented in either magazine for the past "x" number of years. It would take a long time to get any sort of following because no-one is visiting the newsagents and the content will go unseen. I realise it is too late for them. The time has gone. The trend has changed and the youth of today don't see the need to learn electronics because there is simply no future. All the designing and manufacture is done overseas and the electronics careers have all dried up.
Instead of teaching electronics, Universities should teach "Meet and Greet" because that is the only "job" at the K-Mart or Wall Mart store.
The bottom-line is this:
Neither magazine is interested in producing or assisting the beginner with components.
It is a lot of work to provide kits but that is what I specialised in and made a huge success, selling over 300,000 kits with the FM bug kits selling more than 30,000 of one type alone. The magazines could outsource the requirement and charge a commission on sales.
But the plain, cold, hard fact is: they are not interested.
They put on all the pretense of being successful when the statistics from their websites show a different story.
You can't beat statistics. The first IBM computer in the USA (card version) predicted a win by a small margin to a certain political party and IT WAS RIGHT. From that day, political parties have poured over computer figures. If you

don't believe statistics, you are fooling yourself. Look at **Ocean's 11** and study its background.
I have outlived 4 magazines and there are only two more to go.
Such is life.

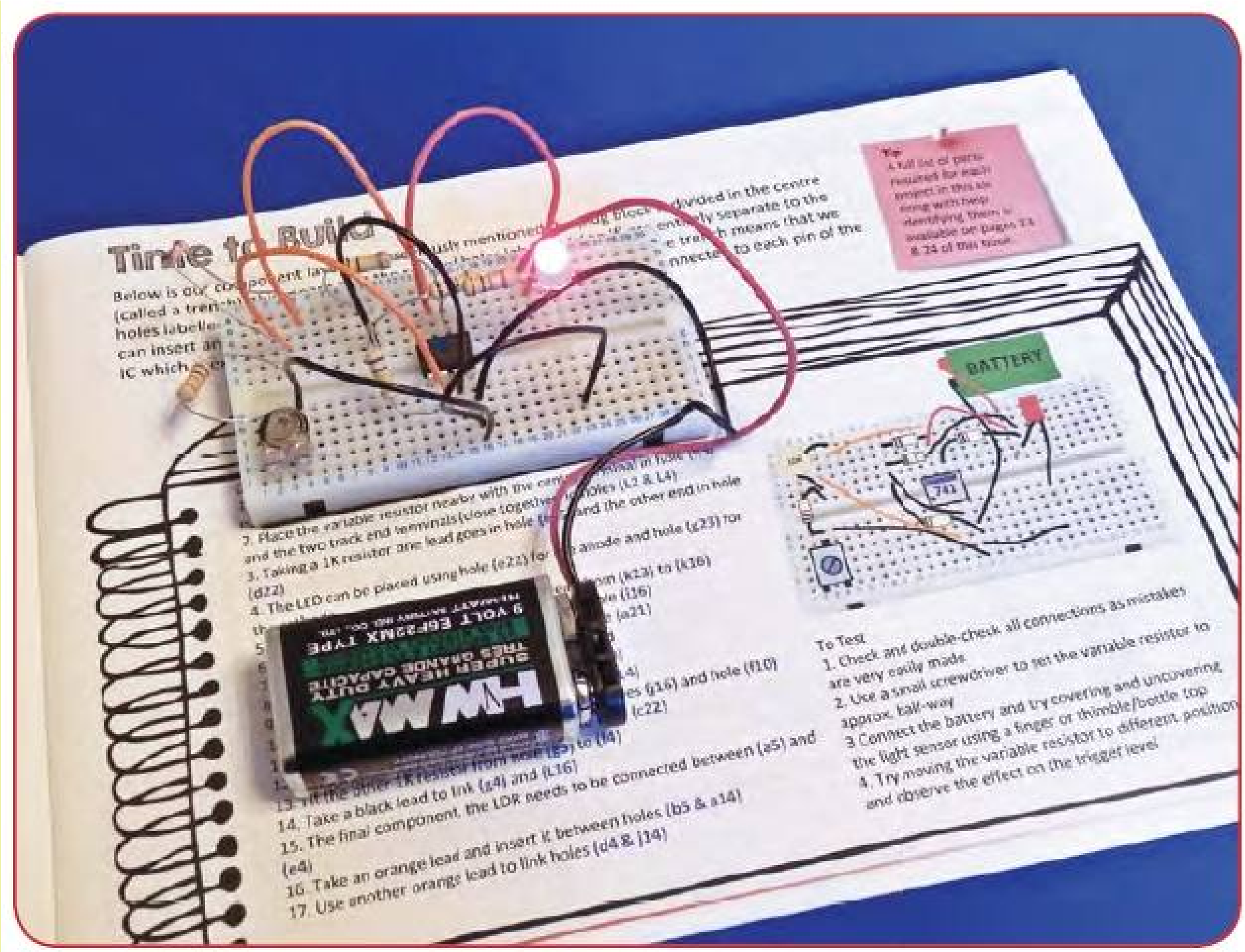
Here is a kit promoted by Michael Tooley in the January issue of **Everyday Practical Electronics**:

Whizzkits Electronics Builder's Kit

Apart from the price of £18 (about $35.00) the kit has a number of major flaws:s:
Here is display of the components:

Fig.2. Contents of the Electronics Builder's Kit

Here is a project:



The major fault with the kit is the BREADBOARD. It is the worst design you can get. It does not have any power rails. It teaches the completely wrong way to lay-out a circuit. Look at the way the leads of the battery are poked into the holes in the breadboard.
This is the sort of photograph I get from readers who don't have a CLUE about electronics and poke wires into the board "all over the place." Where has "Bob" from Spiratronics - the producer of the kit and Michael Tooley, the kit reviewer, been for the past 20 years??? In a cave??? Junk breadboards like this went out 30 years ago.
I would not even purchase one, let alone show a project using one in a PROMOTIONAL ADVERTISEMENT.
And the jumpers. You can get proper jumpers on eBay for one cent each !!!!
Secondly, the kit seems to have just 5 projects. At least with a Tandy kit 30in1 or 100in1 you get a lot of projects to try.
Thirdly the kit does not have a piezo diaphragm, a switch or a pot with a shaft. A piezo diaphragm is very handy for siren circuits and can even be shown to be a microphone.
Why they would provide a sheet of sandpaper to clean the contacts, is beyond me. I have never used sandpaper in 40 years!!!
It's just a "Mickey Mouse" kit. In fact it is an embarrassment to all electronics engineers. And that is as mild as I can get.

Projectsts

The five main projects that can be built with the kit are:
a light-operated switch (which can be extended in order to drive a small relay);
a simple audio amplifier;
a time delay (which can also be extended using a small relay);
a trigger/reset device; and
a heads and tails game.

Michael Tooley says:
The projects are well thought out and cover a variety of different circuits ranging from amplifiers to comparators and light sensors to timers. The circuits are based on a subset of common low-cost semiconductor devices, including LEDs, diodes, NPN and PNP transistors, a 741 operational amplifier and a 555 timer.r.

He says the kit contains 50 components. He has counted ALL THE WIRES too !!! I have never heard of a piece of

wire as being a "component."
It looks like it has ONE capacitor in each range, so you can't even make a flip-flop. What a FLOP !!!!
It's just an overpriced kit where you could buy all the parts separately for $10.00 from an electronics store and get dozens of circuits from the internet. You can also get component identification from the internet. So, why pay $35.00 ???? You can get a proper breadboard for $2.00 on eBay plus 50 jumpers for $2.00 post free.

But that's not the whole story. .

It's fortunate very few beginners will be sucked into buying the kit because **Everyday Practical Electronics** has such a small readership, that almost no-one will be seeing the advertisement.
With a circulation of 10,000 the whole magazine is below viability, however if they are getting the majority of the project-pages "almost free," the small amount they have to spend on "news" items will fill the magazine and they can survive.
It's just the advertisers that are "hood-winked." The advertising blurb still has the old circulation of 20,000 and they have admitted this has dropped to 10,000 in the past 4 years.
At 10,000 it is not worth placing an advertisement.
I have already said the conversion ratio is about 1% and out of those who start to order a kit, only 20% actually place an order.
But this 1% refers to the group of reader INTERESTED in a particular product. The magazines have not presented a beginners project in more than 12 months, so the percentage of beginners reading the magazine will be miniscule.
Most beginners will pick up the magazine at the newsagents and look for articles of interest. Going by my past experience of 30 years in the magazine publishing business, the percentage of beginners is about 20% when suitable projects are presented.
For my magazine it was 100% because that is all I presented.
But for EPE the target audience (to use their terminology) is 2,000. And 1% of 2,000 is 20 orders. At a cost of £500 for the advertisement, each order costs £25 for an £18 kit !!! **Simple mathematics !!**
Some of the shopping carts ask for details TWICE and some will not process an overseas telephone number.
Shopping carts are an absolute disaster as some don't know what postage to charge, some charge exorbitant postage (like $30 for a $5.00 PCB) and some don't process **.com.au** addresses. They simply freeze.
For the kit above, the shopping cart charges £3.00 for an overseas order. Obviously they have NEVER posted a kit overseas !! They will get a shock at the real cost. That's why shopping carts are a DISASTER.

The SOLAR ENERGY scam

I get bombarded with emails every day about getting SOLAR PANELS on my roof.
It all sounds like a good idea but when you go into the economics and environmental aspects, you find a different story.
Let's go back to where it all started and do some mathematics.
This whole thing would not have got off the ground if it were not for government subsidies.
The scheme itself is not sustainable and some clever person persuaded the government to back the idea on the grounds of ENVIRONMENTALLY FRIENDLY - GREEN FRIENDLY - "carbon" friendly NONSENSE.
Let's take the economics first.
The original systems were 1,500 watt for about $3,000.
One kilowatt of electricity costs 20 cents. (actually one kilowatt-hour). This means the solar system generates 30 cents per hour of energy. If the system works for 8 hours a day, it will take 1,250 days to pay-off.
This is 3.5 years. That's not counting cloudy days, interest costs on $3,500 and inefficiencies.
Many of the original purchasers only paid $500 TOTAL COST. The government paid the rest.
But here's the problem: A normal household does not use 1.5kW during the day. The only consumption is a fridge, a light and a TV. This is 800watts. The rest of the energy is pumped into the grid and the owner of the solar system gets a rebate.
Initially this rebate was 60 cents per unit (per kW-Hr) and that's what made the whole idea so attractive.
But who do you think is paying the 60 cents per kW-Hr? The other consumers. Instead of paying 17 cents per unit, they were paying 20 cents per unit to make up the costing.
Fortunately this SCAM has been uncovered and the rebate has fallen to 30cents and sometimes 10 cents.
At 10 cents, the whole SOLAR SCAM is not viable. And neither it should be.
It's exactly like me getting an electric car and because I am not polluting the city with exhaust fumes, I get registration for $100 instead of $500. The government then increases all other registrations to $550 to make up the short-fall.
But let's look at the other figures.
It takes 2 years to re-cover the energy expended into making the panels and how many thousands of gallons of poisoned water is produced to wash the silicon wafers?
The whole concept is so crazy that I never thought it would get off the ground, but then I did not think of the FRAUD

of getting 60 cents rebate on something that cost the electricity utilities less than 8 cents to produce. I never thought they would bow to government pressure like this. It is EXTORTION and imagine if you were producing say plastic bottles for $1.00 and the government said you had to accept used plastic bottles from customers for $3.00 !!!
There is NO DIFFERENCE. FRAUD is FRAUD.
It's just no-one has explained it so clearly.
Now the electricity companies have an oversupply of electricity to the extent of 20%, of which 10% is due to solar panels and 10% is due to everyone cutting down on consumption with LED fixtures and turning off the lights.
This has caused them to increase electricity rates 20%. It's a spiral.
With peak rates climbing to 60 cents per unit due to smart meters, the time will come when households will opt for self-generation with battery-back-up.
A normal household uses 24kw-hr per day and this equates to 1kw-hr, but you have to take into account peak usage.
The biggest user is the tumble dryer. All other high-current devices can be converted to gas.
You can get 5kW inverters and if you are generating 1.5kW, and the dryer takes 2.4kW, you need to supply 1kW from back-up batteries. A cheap "car battery" (12v 40A-Hr) will deliver 0.5kW-hr so you need 3 batteries at $70 each as a minimum back-up.
This will all require a separate inverter unless you have enough batteries to match the voltage of your solar panels.
All this becomes viable when you consider you are paying $200 per year just for the connection of the electricity.
A new connection costs between $300 and $1,000 where they make you pay $350 for the smart meter.
I can remember paying water rates for a property that had no house. Why ???
Because the water "passes the door !!!"
That's what they will do with those who decide to go "off the grid."
No matter which way you look at it, electricity costing is a SCAM.
They sell electricity in bulk to ALCOA (aluminium producers) for 5 cents per kW-Hr.
And the government sells Liquid Petroleum Gas (LPG) to China for 5 cents to 10 cents per litre. It costs us 40 cents per litre.

Here's an incorrect diagram from an Indian publication:

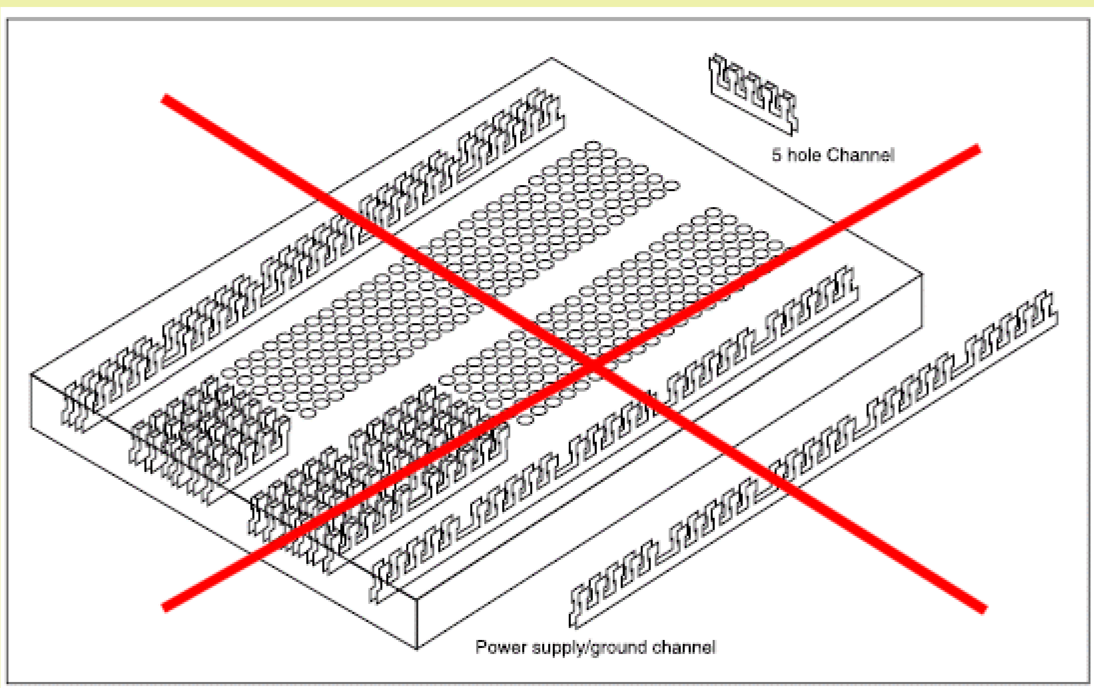
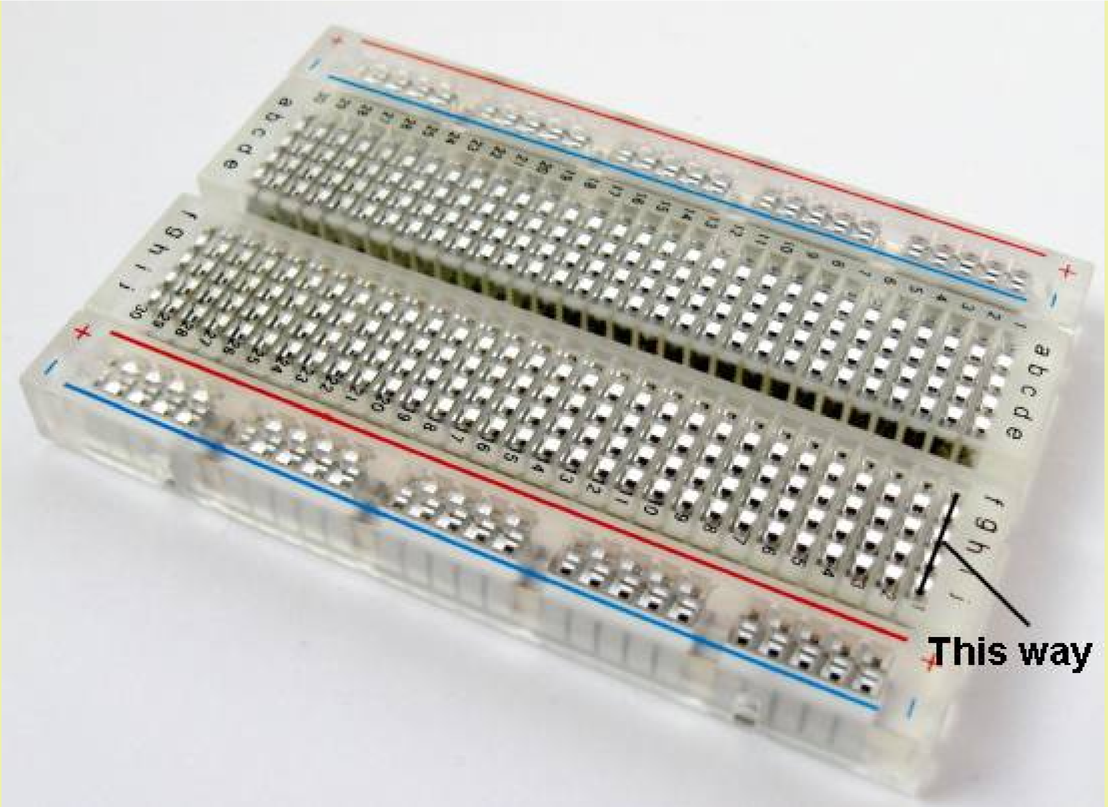


Fig. 47: Conductor channels embedded inside a breadboard

The centre "holes" are connected in sets of 5 as shown:



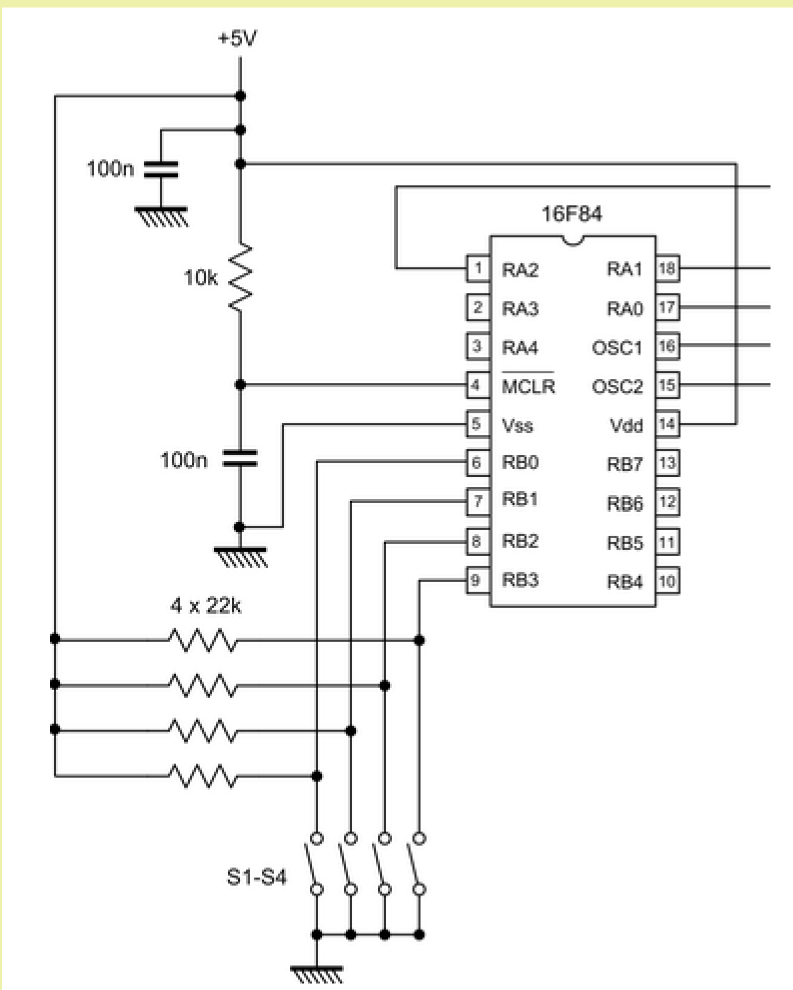
Can you see his mistake??????

When you see all these critiques and criticisms, I am not biased. I have an open mind. If something is well-designed, it gets my tick of acceptance.
Some people are clever and some are not.
One of the cleverest persons in the world was HITLER. Look what he achieved. The Autobahn, the People's car, the submarine, synthetic fuel and improvements to the plane, tank, V1, V2 Rocket. Just through his backing, the design-engineers got to work on so many amazing projects - including the stealth fighter.
When you think of it, the war was also the basis of the Jet, the Computer and the rocket.
One of the most absurd "dreams" was the Jet engine. It was "pooh-pooed" by the British admiralty as preposterous! How can you "blow" an aeroplane along ??? But Frank Whittle was not wrong.
There are (and were) hundreds of clever people who have advanced the world to the conditions we are now enjoying. And I have studied the persistence they displayed in the process to achieving their goal. Look at the "bouncing bomb" and "Tall boy" or the hovercraft.
Why did I bring up this diverse group of people? Because I feel I fit right between.
I have been accepted by some and made a great improvement to many peoples lives.
I was accepted as a teacher and taught hundreds of students.
I was accepted as a technician and repaired over 35,000 TV's, radios and stereos.
When I ran the magazine, I never refused anyone who wanted to work for the magazine.
I gave them the chance in life that I was given on so many occasions.
In fact one of the lowliest workers produced the greatest income for the business.
One day he said: One of the customers has brought in a plastic credit card to pay for the items.
This was the first we had heard of the concept.
I did not want to reject the idea but I was hesitant of its success.
Rather than be "smart," I said I would go to the bank and find out the details. It cost $70 to get an "impression machine" to handle the cards - which was a lot of money.
In the next 15 years, credit card sales rose to 50% of overall sales.
The next thing he comes in and says a customer wants a binder for the magazines.
Again, I took the idea on-board and ordered 100 binders. In the end we sold over 1,000 binders.
Next he comes in and says a customer wants an FM bug kit made-up.
I thought to myself, what hobbyist would want to but a ready-made item??
But this was a person who wanted to use the bug to listen-in.
I asked if this request had been made before and he said yes.
So I got him to make up 10 bugs.
In the end, half of income was built-up products.
So, you never know who has the brilliant idea and rejecting a person can starve the world of great ideas.

That's exactly how I feel when the editors of the two magazines above refuse to include my projects.
It doesn't hurt them, but it is obvious they are refusing all those budding electronics contributors from both Australia and England. I have not seen one budding contributor in either magazine.
That's why I say, they should **not be in charge** of a magazine.
This not only applies to electronics magazines but to all governments, postal systems, utilities, schools, Universities and the list goes on.
To give someone a TER score of 99.95% to enter University is an absolute absurdity. No-one gets anything 100% in any endeavour.
It just gives the student the wrong concept in life.
No-one is perfect and the attitudes I have had from University students would make you cringe.
One student wanted to write for the magazine and when I said I would give him a kit of parts to help design the project, he said: Oh, I don't do soldering."
Another worked on a project for 4 days and hand-taped the PC board. When it came back from the PCB manufacturers, all the circuit was back-to-front. He tried to fix it by bending the legs of the chips around the other way. All the 7-segment displays showed the wrong segments.
The next day he did not show up. I rang him a 9:30. He said: "you can stick your job up your arse."
Comments from the two publishers fall next to what I have encountered from the university students.
That's why professors have slip-on shoes. They have never learnt to tie shoe laces!!
One student: Oh, Professor you have one brown shoe and one black shoe."
"That's funny, I have another pair just like this in the cupboard."
That's why "intelligent" people should not be in charge of things.
They can't even do up their shoe-laces !!!!

Here are some corrections and mistakes on Mike Tooley's website: http://www.miketooley.info/ for **Everyday Electronics Teach-In**

In the circuit shown below, the program memory can be cleared by:



This is a very BAD question because the "program" cannot be "cleared" without erasing the chip.
What does he mean by "cleared"
What does he mean by: "Program Memory"
Does he mean the files used by the program to store temporary data? These will turn into JUNK when the power is removed.
Does he mean the AREA where the program is located? The program is "flashed" or "burnt" into the chip and can be erased when another program is to be "flashed." Some chips can only be programmed ONCE.

The maximum value of current that can be sourced from a single I/O port line of a PIC is:

- 2 mA
- 20 mA **The maximum is actually 25mA**
- 200 mA
- 2 A.

The typical supply voltage for a PIC is in the range:

- 0 V to 6 V
- 2 V to 6 V **The maximum is actually 3v to 5.5v**
- 5 V to 9 V
- 9 V to 12 V.

The principal elements of a microprocessor system are:

The elements are not your PAL !!!!!!

For a bipolar junction transistor, the collector current is:

- only dependent on the base current
- only dependent on the emitter current
- the sum of the base and emitter currents
- (selected) the difference between the emitter and base currents.

I disagree. For a common-emitter stage, the collector current is the SUM of the base and emitter currents.

An application for a zener diode is:

- (selected) a rectifier
- a current limiter
- a power indicator
- (selected) a voltage regulator.

A zener diode CAN be used as a rectifier. In fact ALL diodes are zener diodes but the zener (or breakdown) voltage of most diodes is higher than the voltage being rectified and that's why the zener or breakdown voltage is not impotent. You can see a circuit where I used a zener diode to produce a fixed output voltage

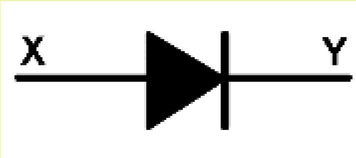
A typical operating current for an LED indicator is:

- (selected) 10 to 25 mA **High bright LEDs are quite visible at 1mA !!!**
- 25 to 100 mA
- 100 to 200 mA
- more than 200 mA

The typical forward voltage drop for a diode is:
- (selected) 0.2 V for a germanium diode and 0.6 V for a silicon diode **NO**

The industry recognised voltage drop for a germanium diode is 0.3.
The industry recognised voltage drop for a Schottky diode is 0.2v

The connections marked 'X' and 'Y' below are:



- X = emitter, Y = collector
- X = collector, Y = emitter
- X = anode, Y = cathode
- Y = cathode, X = anode.

The last two answers are THE SAME !!!!

A typical power rating for a soldering iron for electronic work would be:

- 18 W
- 50 W
- 100 W
- 150 W.

Both 18watt and 50 watt are correct as a temperature controlled soldering iron is only turned on for a very short period of time.

In his sample chapter: chapter (4.6 Mb PDF)
He shows an N-Channel FET being tested with a NEGATIVE voltage on the gate:

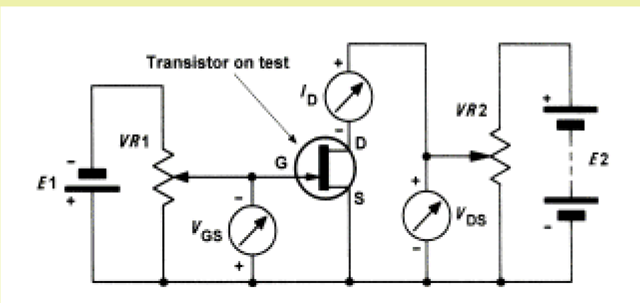


Figure 5.31 N-channel JFET test circuit (the arrangement for a P-channel JFET is similar but all meters and supplies must be reversed)

The gate voltage needs to be positive to turn the FET ON.

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SPOT THE MISTAKES!

Page 23

These pages are one of the most important features of our website.
They show how easy it is to produce a mistake.
It's very easy to forget to include something, but it is unforgivable to state something that you haven't researched or checked (by simply Googling the answer).
We all thought Google was a made-up word until its meaning came through as the "amount of money you need to retire on" - $\$10^{100}$
A $1,000 life insurance policy in 1920 could buy a double-brick house. In 2104 it does not pay for a coffin.
You need $1,000,000 to retire comfortably and this will just buy a rental property to provide a good living.
What will be the statistics in 20 years?
That's why you need a plan to set-up a business that will see a good return so you can buy into the rental market.
Houses are the only reliable safe-guard. Everything else can rise and fall.
You need to think of a product you can market and promote for years to come.
And electronics can do this if you look into the fields of health, aids, and toys.
They are all areas where hundreds of thousands of units are sold and if you simply look around and see something that YOU need, chances are OTHERS WILL NEED THEM TOO.

My biggest regret with TE website is this: I didn't organise it as an ENCYCLOPAEDIA.
There are so many facts and circuits on the site that it will fill a book.
Most of the information is NEW and not just a re-gurgitation of text-books from the past.
Text books are wonderful. But they are frustrating. They explain a point in such a way that the beginner doesn't understand what is being said.
Two facts come to mind:
No text book has explained how the protection diodes on the input of a CD4001 or

CD4011 discharge the capacitor in an oscillator.
Text books also say: A collapsing coil produces a voltage IN THE OPPOSITE DIRECTION.
The word: "back EMF" does not have the same impact as saying: the voltage is produced in the REVERSE DIRECTION. Once you realise it is a REVERSE VOLTAGE, you can understand how a TUNED CIRCUIT WORKS.
However I made a huge change to the website when I introduced "frames" and added the left index. This allowed easy access to all the folders.
But if I had added alphabeticalisation and links within each of the articles, the reader would be able to refer to other articles in the website.
Fortunately we have an answer.
Simply use Google. Type: talkingelectronics.com tuned circuit into the address bar and within 0.001 seconds you will have all the occasions where I have used this term.
Every word in every sentence of Talking Electronics website has been indexed by Google.
That's the power of the "robot."

Here's some more mistakes from Mike Tooley's text book:

Figure 12.7 shows how the standard 555 can be used as an **astable pulse generator**. In order to understand how this circuit operates, assume that

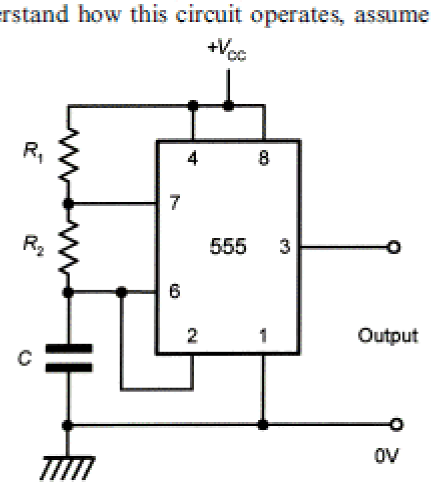


Figure 12.7 555 astable configuration

the output (pin-3) is initially high and that TR1 is in the non-conducting state. The capacitor, C, will begin to charge with current supplied by means of series resistors, $R1$ and $R2$.

When the voltage at the **threshold** input (pin-6) exceeds two-thirds of the supply voltage the output of the upper comparator, IC1, will change state and the bistable will become **reset** due to voltage transition that appears at R. This, in turn, will make the inverted O output go **high**, turning TR1 at the same time. Due to the inverting action of the buffer, IC4, the final output (pin-3) will go **low**.

I can't work out what he is talking about, and I have studied the 555 for 25 years !!!
There is No TR1, no IC1, what "buffer" ???

How do you expect a beginner to understand this gobbeldy gook !!!

The "STOP" should be called "RESET."

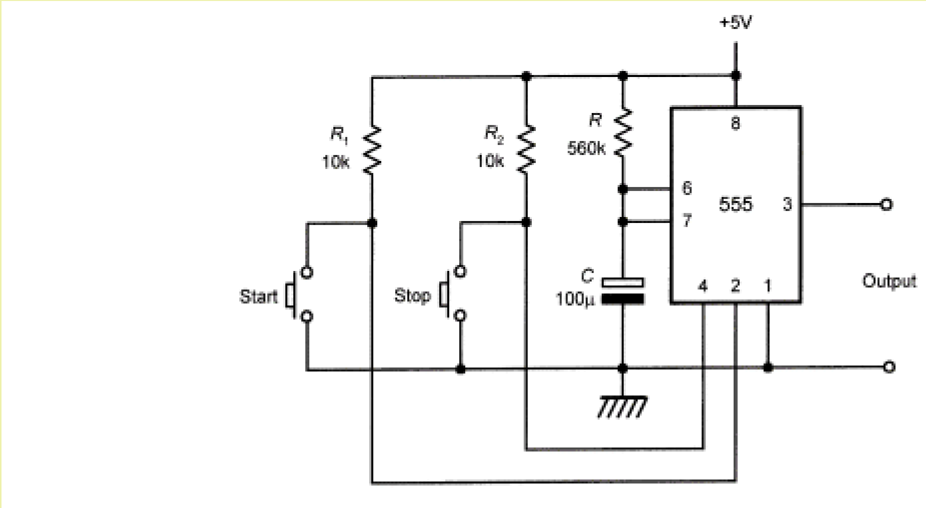


Figure 12.6 60 s timer (see Example 12.2)

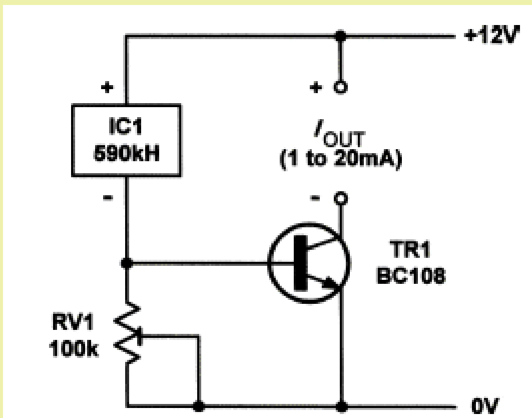
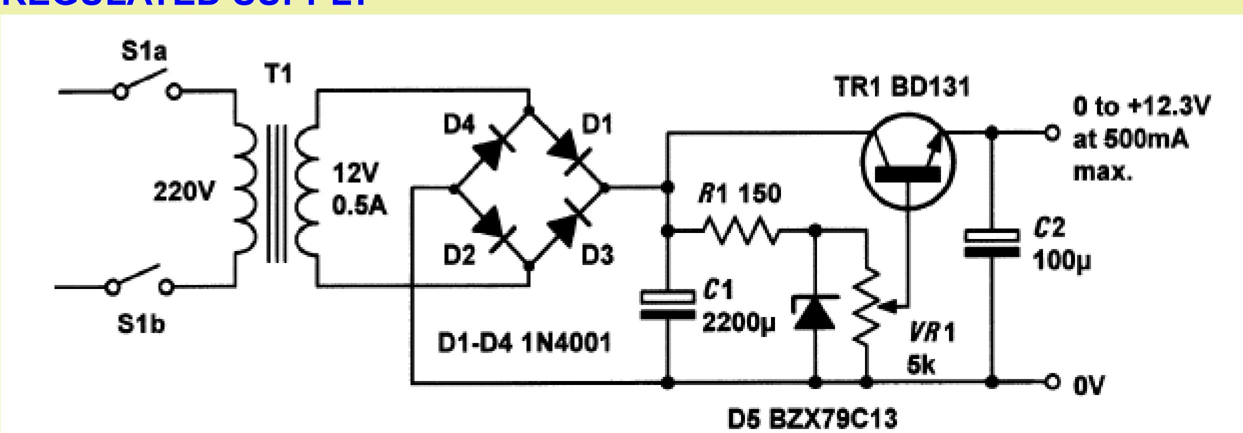
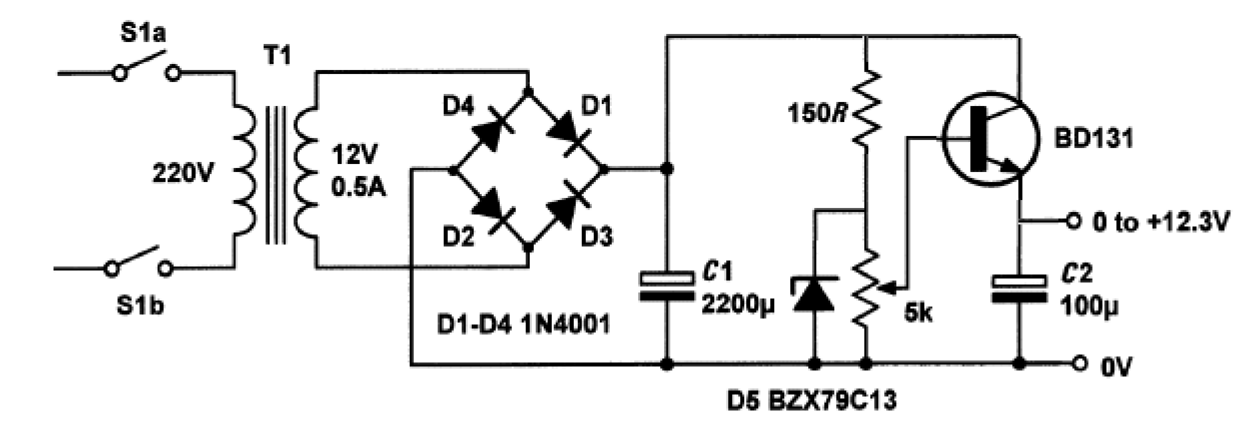


Figure A1.2 Heat-sensing unit circuit for Assignments 1 and 2

590kH is a $30.00 temperature sensor !!
You can buy a complete IR temperature "gun" for $25.00!!

REGULATED SUPPLY

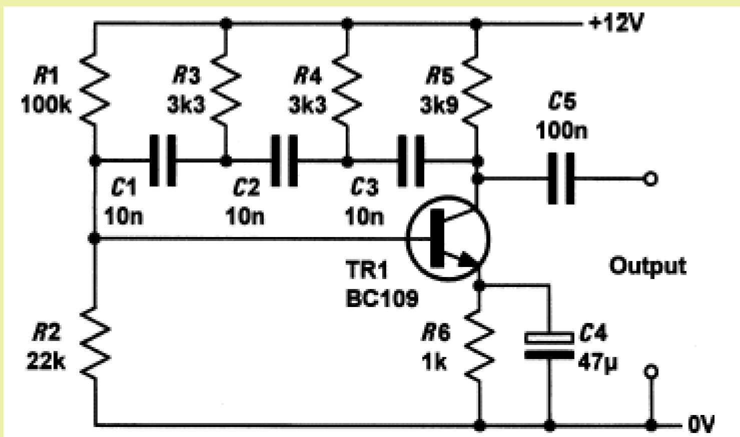


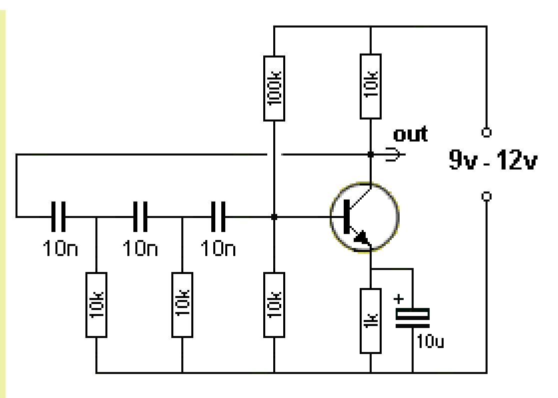


All the writings in this books are simply a re-gurgitation of things you can find in ANY text book. Nothing has been explained in a way that is NEW or easy for a beginner to understand.
Take the Regulated Supply for example.
The output transistor is actually an EMITTER-FOLLOWER and when you draw the circuit as shown in the second diagram, this is obvious.
The pot forms a voltage divider in which the slider (the wiper) is picking off a voltage from 0v to 13v from the outer track of the pot.
This is passed to the transistor and it "rises and falls." The emitter lead is the output and it is always 0.7v below the voltage on the base. That is why it is called a "follower."
But the transistor provides an additional feature.
The emitter voltage is much smoother than the voltage on the collector. And this is why:
As you increase the voltage (by turning the pot), the current required by the load will increase and the voltage on the 2,200u can drop from say 15v to 14v. This is because the electrolytic is like a miniature rechargeable battery and it charges-up when the voltage is high and delivers its energy when the voltage is lower.
But when the current you are drawing for the circuit increases, the electrolytic cannot deliver enough energy and the voltage "dips." There will be 100 "dips" for a 50Hz input from the mains.
If you deliver this voltage directly to an amplifier you will hear a lot of buzz and hum. But if you are able to use the voltage UP TO 14v, the result will be perfect.
That's what the transistor does.
It just uses the voltage from 0v to about 13.9v so no hum is delivered to the output.
So, what happens in reality is the output voltage can reach a maximum of 12.3v and the 15v appears on the collector so the transistor "deals" with 15v - 12.3 = 2.7v across the collector-emitter terminals (collector-emitter junction). The voltage can go as low as 14v - 12.3 = 1.7v across the junction.
The transistor can only perform this "magic" with currents up to 350mA because the transformer can only deliver 500mA AC and when this is passed to the transistor, the current must be de-rated.
WHY?
Because the wattage delivered by the transformer is an **AC rating** of 12v and 0.5 amps = 6 watts. The 12v is an RMS value and when it is rectified, it emerges from the bridge as a peak value. This value is 40% higher than 12v and becomes 17v. So, to keep the wattage emerging from the rectifier **6 WATTS,** we must **DE-RATE** the current by 40%. In other words xxmA x 17 = 6 xx = 6/17 = 350mA
This explanation has been missed by Mike Tooley. He said the circuit is capable of supplying up to 500mA. This is UNTRUE.
Instead of my simple explanation, he says the transistor is used to provide current gain. How is a beginner supposed to know what that means????
He doesn't explain ANYTHING.
But what he is trying to say is this:
The zener is providing a stable voltage of 13v. If you use a high-wattage zener and a high-wattage wire-wound pot, you could get 0v to 13v from the wiper (slider) and remove the transistor.
But this would produce a lot of wasted heat and the circuit would be very inefficient and completely "unregulated."
By using a transistor we can reduce the wattage of the zener to 1% and the wattage of the pot to 1% and get REGULATION. This is because the transistor has a gain of 100. We are saying the transistor has a gain of 100 to make our discussion easy to understand.
The transistor will amplify the current one-hundred-times. It will amplify the current into the base one-hundred-times.
This is what he means by **the transistor is used to provide current gain.**
The current into the base will be multiplied 100 times and this is the maximum current that can be delivered by the collector-emitter leads.
But Mike Tooley does not realise the current into the base is very small. He has not worked out the actual current

that will be delivered as the pot is rotated.
This value MUST be worked-out if you want the circuit to work.
This is called the CURRENT-SIDE to designing the power supply.
The output current will be 350mA, so the base current will need to be 3.5mA.
This 3.5mA will be "robbed" from the zener.
In other words, the zener must pass more than 3.5mA because we will be taking 3.5mA from it.
The voltage on the 2,200u will be 12v x 1.4 - voltage drop across two diodes = 15.4v
The zener voltage is 13v so the current through the 150R will be 16mA.
The zener is passing 16mA and we want to rob 3.5mA. This part of the circuit is correct.
BUT:
The current through the 5k pot will be as low as 2.6mA when it is turned towards the 0v rail. So you can see the pot will not be able to deliver the 3.5mA required by the transistor.
The pot should be 1k. But a 1k pot will allow 13mA to flow and this will make the pot very HOT.
This is where the circuit "FALLS OVER." It has not been tested or designed correctly.
The transistor actually has a maximum gain of 70 and is a very poor choice for this circuit.
The end result is: THE CIRCUIT DOES NOT WORK.

SINEWAVE OSCILLATOR





These circuits produces a sinewave very nearly equal to rail voltage.
The important feature is the need for the emitter resistor and 10u / 47u bypass electrolytic. It is a most-important feature of the circuit. It provides reliable start-up and guaranteed operation. For 6v operation, the 100k is reduced to 47k.
The three 10n capacitors and two 10k resistors (actually 3) determine the frequency of operation (700Hz).
The 100k and 10k base-bias resistors can be replaced with 2M2 between base and collector.
This type of circuit can be designed to operate from about 10Hz to about 200kHz.
Both these circuits are NOT VERY RELIABLE. They work with some transistors better than others. They stop working when you touch some of the parts. The frequency changes when you add a 100u across the power rails. They are too fiddly to be recommended. Place a piezo diaphragm across the collector load and experiment yourself. Try changing the 1k and try 6v to 12v to see what I mean.

Mike Tooley says: *This is the book that I wish I had when I first started exploring electronics nearly half a century ago.*
Apart from the fact that many of the explanations are given in a complex way, nowhere in his book does he

mention the **TUNED CIRCUIT**. This is the most important building block to be invented. It pioneered the ability to transmit a signal over a long distance with very little power and obviously was the basis to RADIO. Without radio we would not have TV, RADAR, internet and the most important thing of all APPLICATIONS ON iPHONES.
He also mentions the inductor and the fact that the voltage produced by a collapsing magnetic field produces "back e.m.f "
But that will go over the head of a beginner without saying this is the most amazing thing of all. The voltage produced by an inductor (when it is turned OFF) produces an OPPOSITE POLARITY VOLTAGE (to the supply voltage) - a voltage IN THE OPPOSITE DIRECTION.
Once you know this, you can work out how a capacitor and coil in parallel produce a natural sinewave without any other components. And the voltage they produce can be TWICE the value of the supply !!!! It is called a **TUNED CIRCUIT** or **TANK CIRCUIT** (when referring to radio circuits and transmitters).

Mike Tooley has never learnt how to draw circuit diagram. That's because they don't mean anything to him. He draws 555 blocks with pins "all over the place" and connections to these pins all over the circuit.
In fact he has hardly covered the 555 at all. This is one of the most popular chips and he has only shown a few circuits.
Also he has not even covered the most universal Schmitt Trigger IC - the 74c14. This is a hex Schmitt Trigger with an enormous number of applications.
As I said, it is obvious he is not a "down-to-earth" design engineer and cannot relate to the circuits because he has never even built any of them.
One FLIP-FLOP circuit does not make you a DESIGN ENGINEER.
His book is like giving you all the fancy LEGO BLOCKS without the 3 BASIC BLOCKS. What can you build ??
No transistor circuits, no gate circuits, no microcontroller circuits - no nothing.

Here is a paragraph from 2015 "Teach-In."

The maximum total power dissipation is important in a number of applications, particularly for devices where appreciable power is being delivered. In the case of this family of devices, the total power dissipation (the sum of the power dissipated in the two junctions) should be no more than 500mW. So, in an application where the collector-emitter voltage is 15V and the collector current is 400mA the device will be operating outside its maximum permissible ratings even though the collector-emitter voltage and collector current do not individually exceed the manufacturer’s specification.

What is he talking about ???
I don't know. How can a beginner understand this ???

You don't calculate 500mW by multiplying 15v by 400mA. 500mW is determined by measuring the voltage across the collector-emitter terminals when 400mA is flowing. The voltage might be 300mV to 800mV.
If the transistor is turned on FULLY, the collector-emitter voltage will be about 300mV. If the current is 1,000mA, the dissipation will be 300mW. (1,000 x 0.3)
If the base current is not sufficient to FULLY turn the transistor ON, the collector-emitter voltage will be higher than 300mV and can be say 800mV. In this case the dissipation will be 1,000 x 800 = 1,000 x .8 = 800mW and the transistor will overheat.

Here's more "technicalese" that needs simplification. Remember, he is supposed to be talking to BEGINNERS:

Amplifiers have four terminals (two for the input and two for the output) but since transistors have three terminals one of the transistor’s terminals must be connected in ‘common’ with one of the input terminals and one of the output terminals. This connection is variously referred to as common or signal ground, and it is often the same connection as that used for the 0V supply. In fact, both of the supply voltage connections to an amplifier are common, at least as far as the signal (AC) is concerned. At first sight, this might sound odd, particularly as there is a DC voltage drop between the supply voltage rails, but it is important to remember that the supply exhibits a very low impedance at signal frequencies and therefore appears as a short circuit as far as the signal is concerned.

The above may be correct but it is not easily understood.

Here is a simplification:

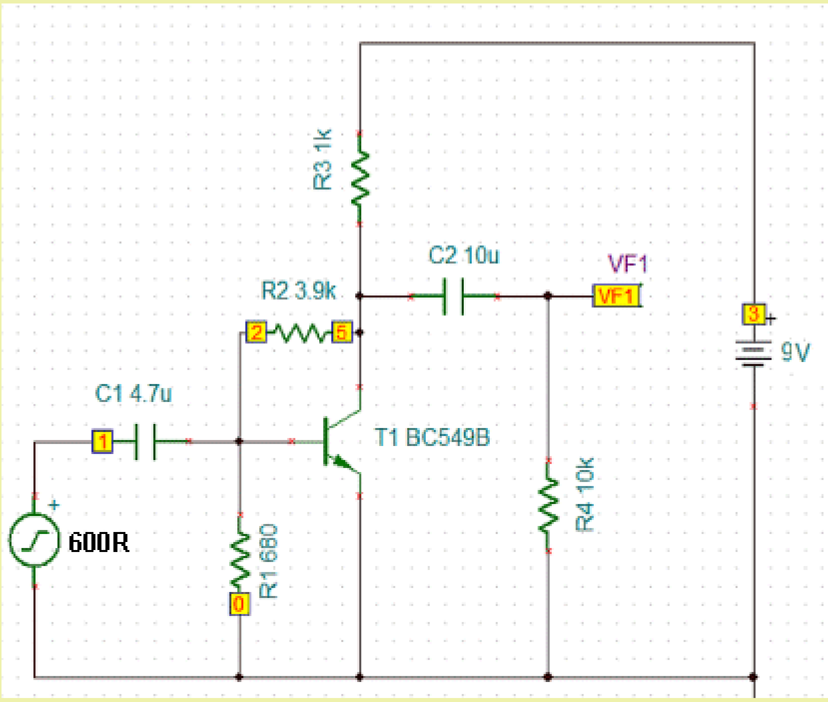
Amplifiers have four terminals (two for the input and two for the output). The input is connected between the base of a transistor and 0v rail. The output is connected between the collector and 0v rail.
This way of connecting is referred to as COMMON or SIGNAL GROUND, as the 0v rail is common to both the input and output.

What does this mean: "*both of the supply voltage connections to an amplifier are common, at least as far as the*

signal (AC) is concerned."

What he is trying to say is this:
All circuits have a "top" and "bottom" rail. These are called the SUPPLY. The top rail is called the SUPPLY RAIL and may be 6v, 9v 12v or as high as 100v.
The bottom rail is called the 0v rail. If you are working on automotive circuits, it can be called CHASSIS or "earth."
Don't ever talk about the supply as being a short-circuit.
But you can say the resistance between the positive and 0v rail is very very small. Because this resistance consists of the effect of an electrolytic across the supply rails and the internal resistance of the battery or power-supply delivering the voltage and current to the project. We say the IMPEDANCE of the supply rails is very small.
We only talk about resistance when we have a 1 ohm to 1M resistor in a circuit. If we have a speaker, coil, transistor or capacitor in the circuit, the resistance we measure with a multimeter will be different to the "resistance" seen by the circuit **WHEN IT IS WORKING** and that's why we use the term IMPEDANCE.

Here we have a pre-amp circuit for beginners.



Although the circuit may work, the 680R resistor between the base and 0v rail will reduce the signal to less than 10% as the input impedance of the transistor is about 5k.
The 4u7 will also reduce the signal a small amount.
But why teach beginners with a poorly designed circuit ????
I have never seen this type of circuit used to amplify a 600 ohm source.
Why reduce the signal to 10% then amplify it ????
The three resistance values are FAR TOO LOW for a small signal amplifier. They should all be at least 10 times larger.
Mike Tooley has absolutely no idea what he is doing. If he doesn't know, how do you expect a beginner to understand???
This type of circuit is actually divided into 3 different categories. SMALL-SIGNAL AMPLIFIER, MEDIUM-SIGNAL AMPLIFIER and LARGE-SIGNAL AMPLIFIER. (SMALL-SIGNAL STAGE, MEDIUM-SIGNAL STAGE and LARGE-SIGNAL STAGE.)
What we are really saying is "small-current" "medium current" and "large current." The current in a "large current stage" is MUCH LESS than a POWER STAGE.
The circuit above is called a "medium signal stage" and is NOT interfaced to a 600 ohm signal. A 600 ohm signal is classified as a medium-impedance signal and must be interfaced to a medium-impedance stage to get good matching and allow most of the signal to be signal to be accepted. There are always losses when matching a signal to a stage when a capacitor is present on the input but adding the 680R is totally unacceptable as less than 10% of the signal is passed to the base.

2-TRANSISTOR AMPLIFIER

Mike Tooley claims the output impedance of this amplifier is 30 ohms.

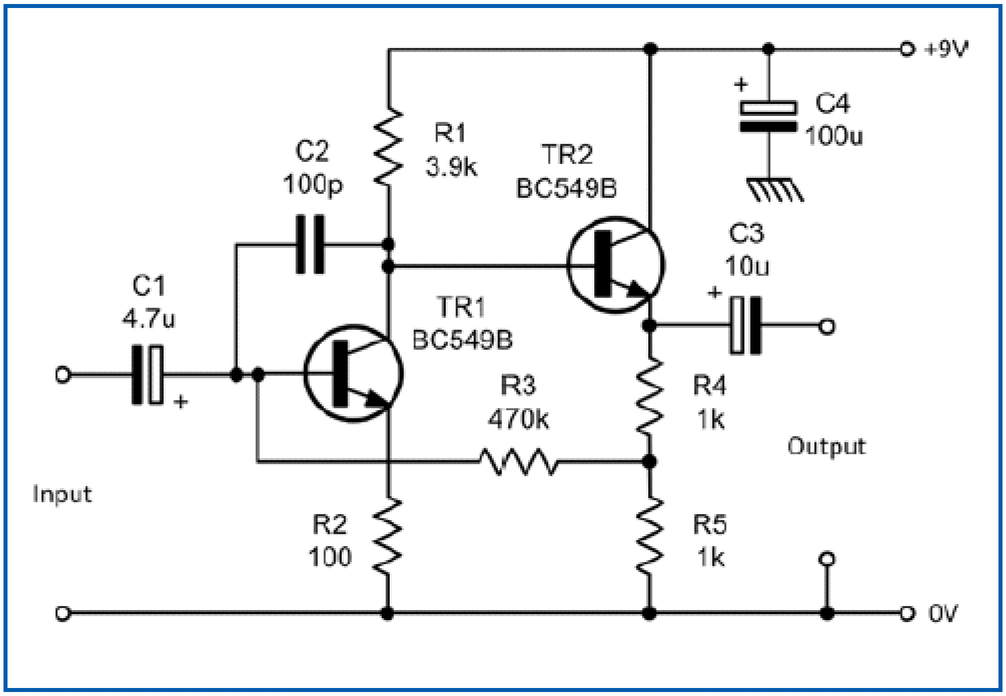
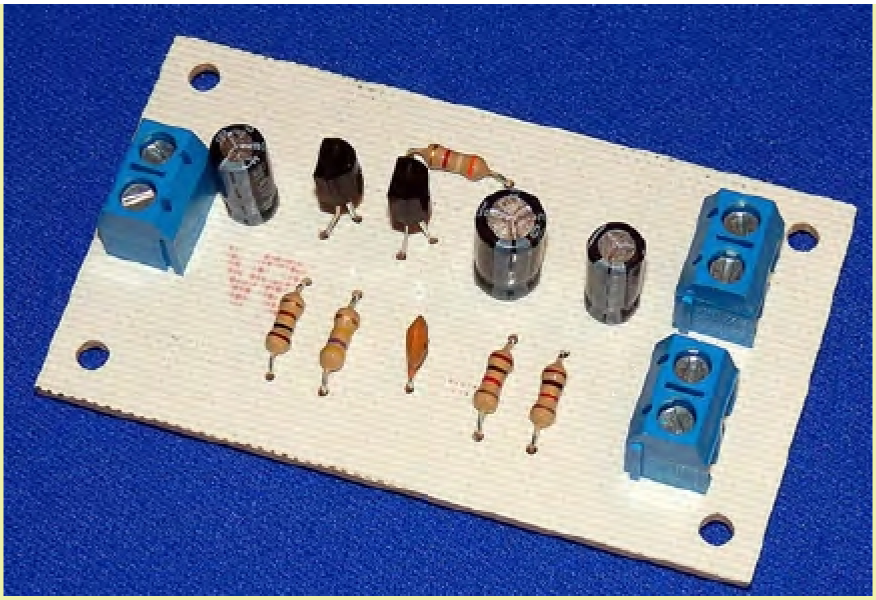
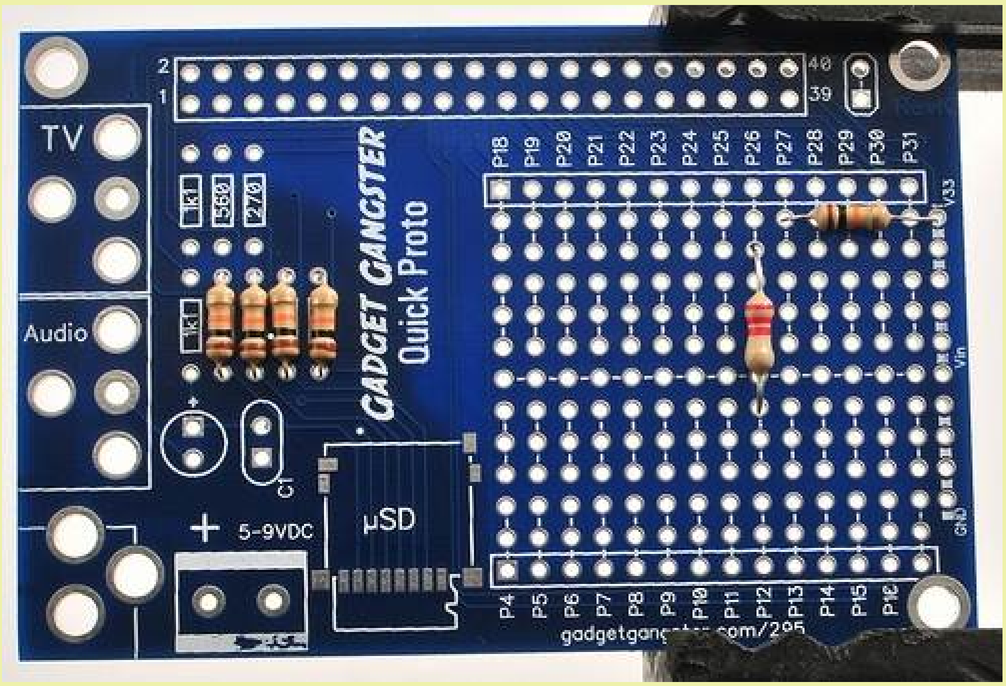


Fig.1.17 Circuit of the versatile pre-amplifier

This is NOT TRUE. The transistor may be able to "pull-up" and deliver a current to the load via the electrolytic. But when the transistor turns OFF, the two items that DISCHARGE the electrolytic are the 1k resistors. (2k total). If you don't discharge the electrolytic, the transistor cannot charge it during the next cycle.
This fact has been completely forgotten by Mike Tooley.
He states the input impedance is 20k and output is 30R. And yet he uses 4u7 on the input and just 10u on the output. This shows a complete lack of understand of impedance-values.

Here is the "junk" PC board designed by Mike Tooley for the 2-transistor amplifier circuit above. It has no overlay. I was the first person in the world to provide FREE PC boards with a magazine, over 30 years ago, and they all had an overlay (called a LEGEND).
In addition, the name of the project was printed on the board. How you can produce JUNK like this is beyond me. He obviously has no respect for electronics.
In addition, putting R1, R2 etc on a board is pointless. All my boards can be assembled without any further instructions as the component values are on the overlay.
You can instantly identify a capable electronics engineer by his work. This is sheer JUNK. The PC board costs $15.00 from Everyday Practical Electronics. Who is going to pay $15.00 for a piece of junk like this:

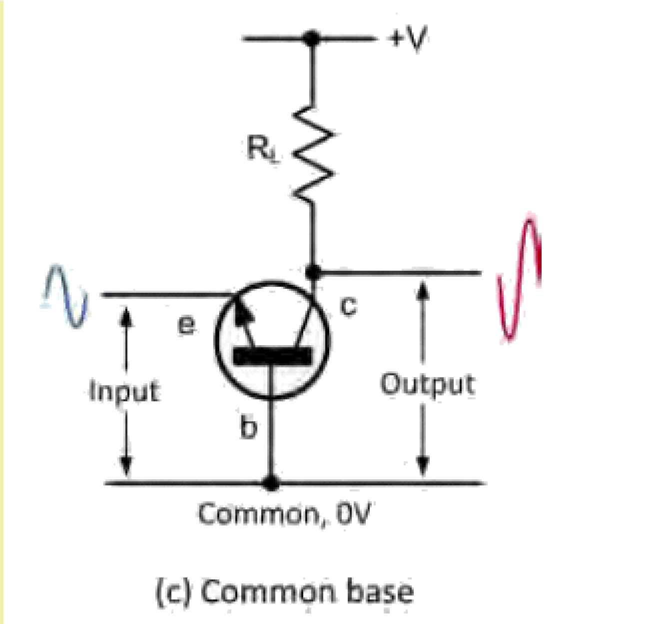




Look at the quality of this board from Gadget Gangster

PC boards made by Chinese manufacturers cost LESS than doing it yourself.
The board above is a double-sided, plate-through-hole with tinned solder-lands and a legend on both the top and bottom.
It is made by Nicholas McClanahan, a hobbyist who takes pride in his work and produces BEAUTIFUL boards.
This is the sort of quality that should be presented in Mike Tooley's text book, to show the reader HOW things should be done.

Here's a piece of re-gurgitation I spoke about above:



(c) Common base

It is a common base stage.
Although the arrangement is correct, a practical arrangement is different. More biasing components are needed.
The operation of the stage is not covered in the text. Why include an impractical layout for a beginner and fail to describe it. ????
The common base stage will interface (connect) a very low impedance transducer (such as a speaker or coil) and amplify the signal 100 to 200 times with minimal distortion because of the direct coupling. One or two practical circuits are needed to show the value of the surrounding components.
The author is treating the readers as IDIOTS. He is asking them to buy a magazine and then producing HOT AIR. You can get better information on the web FOR FREE.
The Phase Shift for a common base stage is 0°. In other words, the input and output are IN PHASE. The waveforms on the diagram above are NOT CORRECT. The red output wave should be drawn "up-side-down."

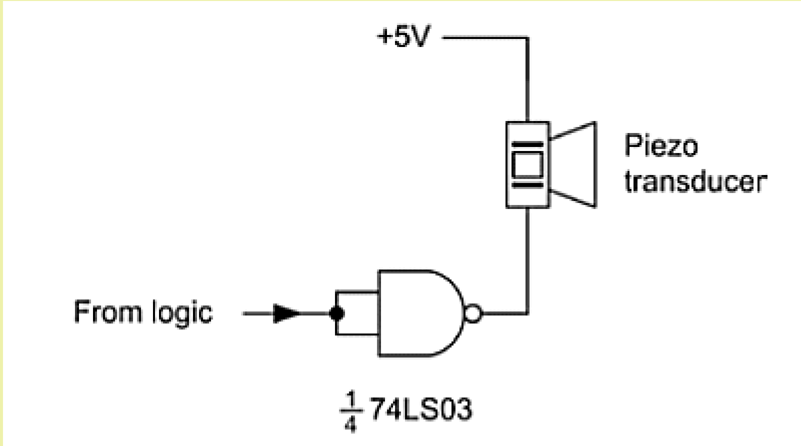
Mike Tooley claims the voltage gain of common-emitter stage is Medium/High (40). However the gain depends on how the stage is biased. Self-bias gives a gain of about 70 but other biasing arrangements can produce 100 to 250 or more. Power stages can be as low as 10 to 25.

Mike Tooley also talks about transistors with a gain of 100, 220 and 450. What he fails to mention is this:
When a transistor is placed in some circuits, the resulting gain of the stage is almost the same for any of the transistors.
It all depends on the way the circuit is biased. After all, biasing is designed to maintain the same gain, irrespective of the temperature of the transistor and also produce nearly the same stage-gain for a wide variety of transistors.
It is only under very special circumstances that the full gain of the transistor can be obtained. In fact it is so hard to determine the gain of a stage before-hand, that you need to build the stage and try different transistors to see if any variation is produced.
The worst common-emitter stage has the base resistor connected to the positive rail and the resistance of the collector load is adjusted to produce about half-rail voltage on the collector. If the transistor is replaced or heated, the collector voltage will rise or fall considerably.
The next worst common-emitter stage has the base resistor connected to the collector. This is called SELF BIASING and the collector voltage will change slightly if the transistor is heated or replaced. It is much better than the worst stage but transistors with a gain of 100 will produce a high voltage on the collector and a transistor with a gain of 450 will produce a low voltage on the collector.
The next type of common-emitter stage has an additional resistor between the base and 0v rail.
The produces a lot more stability but it decreases the gain of the stage considerably.
Finally, biasing via 4 resistors in a "bridge" arrangement provides a high degree of stability but the gain of the stage is reduced.

He also throws in things like this: Notice that there is a fair amount of variation across the three gain groups. For example, the data shows that the input resistance (hie) for a device in Group C could easily be more than four times greater than that of a device taken from Group A.
He offers NO EXPLANATION - so why bring it up??????? He does not know the answer !!!
The reason is this: all the transistors are tested with a collector current of 2mA. To produce a collector current of 2mA with a transistor having a gain of 100, requires .02mA (20uA). To produce a collector current of 2mA with a

transistor having a gain of 400, requires 5uA and the base-emitter junction will not be turned ON as much and it will "appear" to have a higher impedance.

Mike Tooley says: "where direct voltage is amplified as well as AC." I have NEVER heard of: "direct voltage."



(b) Using an open-collector logic gate

How does the circuit remove the charge on the capacitor (the piezo is a capacitor) when the output of the chip is "OPEN COLLECTOR."

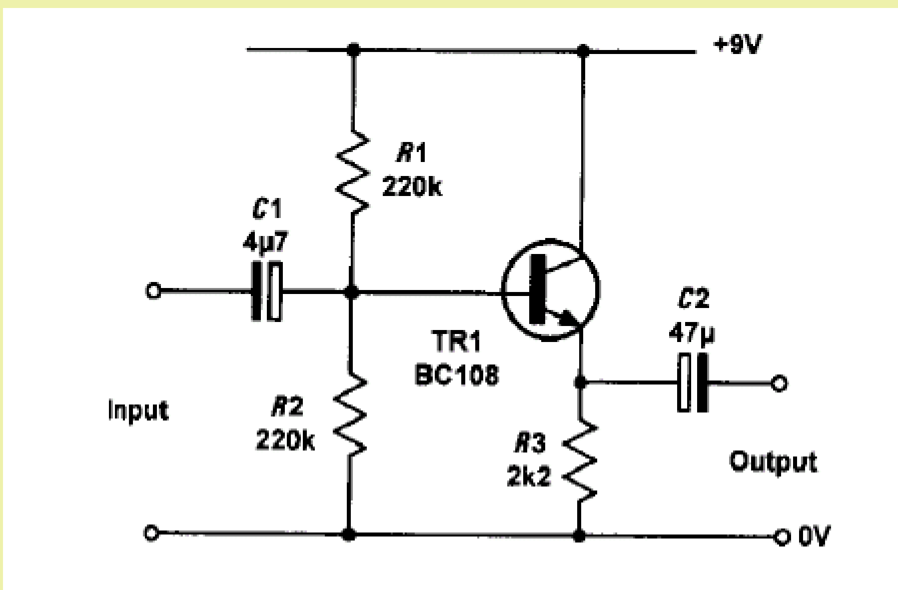


Figure 7.42 An improved emitter-follower stage

How is the circuit improved ???? Mike Tooley does not say !!!!!

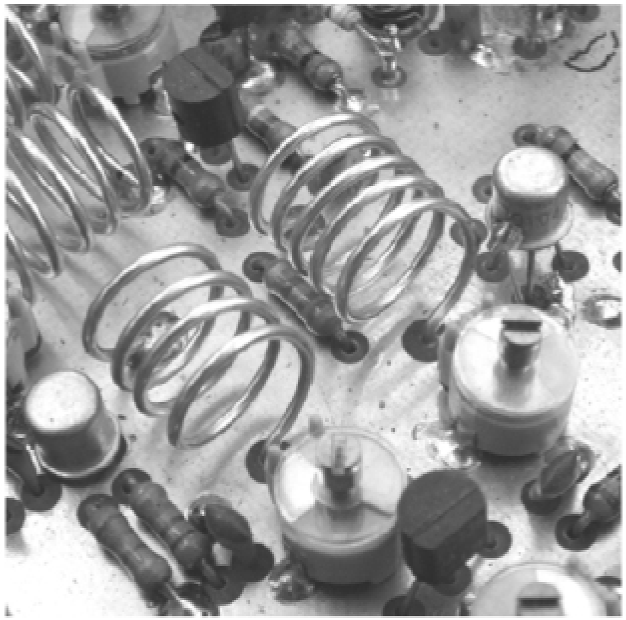


Figure 4.22 Resonant air-cored transformer arrangement. The two inductors are tuned to resonance at the operating frequency (145 MHz) by means of the two small preset capacitors

Mike Tooley claims these two coils make a transformer. They are so far apart that the magnetic flux from one coil will have very little effect on the other.

His coverage of 5 band resistors is very poor. It is NON-EXISTENT.
5-band resistors are easy to read if you remember two simple points. The first three bands provide the digits in the answer and the 4th band supplies the number of zero's.

Reading "STANDARD VALUES" (**on 5-band resistors**)

5-band resistors are also made in "Standard Values" but will have different colours - and will be confusing if you are just starting out. For instance, a 47k 5% resistor with 4-bands will be: yellow-purple-orange-gold. For a 47k 1% resistor the colours will be yellow-purple-black-red-brown. The brown colour-band represents 1%.

He has 3 pages on soldering and NOT ONCE does he talk about the diameter of the solder.
He has NEVER SOLDERED IN HIS LIFE.
You must use solder with a diameter LESS THAN 1mm.
0.8mm solder makes a much better connection than 1mm and 0.6mm makes a PERFECT connection.
I have never seen this mentioned in any soldering articles.

Another wasted chapter is on MICRO's. He discusses the Z-80 and PIC micro in general terms but does not offer any first-hand commentary.
the Z-80 was one of the first 8-bit microprocessors but needed an external clock, RAM, ROM and decoders as well as latches to get anything up-and-running.
It had about 700 instructions but you very quickly ran out of registers to store information.
Almost all the capability of a Z-80 can be handled with a PIC16F628 at $1.50 and the PIC chip has only 35 instructions to remember. Out of these, you only use about 10 on a constant basis.
He covers the 35 instructions (called mnemonics) because each letter of the instruction represent a word in it capability. But he then presents a program in "C" and never covers a program in ASSEMBLY (a program using the 35 instructions).
It's only someone like me, who has worked with both micros, that can review the chapters and see how badly they have been presented.
A newcomer simply says: "microcontroller programming is NOT for me."
His text book has not give me any incentive to study electronics and you can find more-exciting discussions on Instructables or Make.

I also have a point-of-difference with the way he has described the operation of a simple common-emitter stage. The stage is biased with a base-resistor to the positive rail and although he has described its operation correctly, this type of biasing is never seen in reality as it depends HEAVILY on the gain of the transistor to maintain half-rail voltage on the collector.

He covers the base current required to obtain mid-rail voltage and then talks about a 15uA input signal to produce a 3v signal on the collector. This is all correct, but in reality, how are you going to find, detect and view a 15uA signal. You may be able to view all this on a simulation package, but in reality a Cathode Ray Oscilloscope only displays signals with AMPLITUDE.
That's why you have to decide if you want to build "pretend" circuits or learn how to diagnose actual circuits.
He should have made this clear to the beginner and gone on to describe a self-biased stage.
What he has described is quite NON-FUNCTIONAL and useless.

Simply looking at the comments and mistakes above, it is clear Mike Tooley does not have a firm understanding of the basics of electronics.
An email from Mike Tooley confirmed my thinking. He has no idea how the Regulated Supply (circuit above) works and how to comment about the mistakes.
We will see what mistakes appear in the second installment of **Teach-In 2015**.

I received this email today and I am going to respond to it because it brings up two points from the current item.
If anyone sends and email with any derogatory comments I will also present them too, because I intend to cover everything and not filter anything out.

This email comes from Dave Thompson NZ

The magazine subscription figures seem very low and it would be almost not worth publishing. The projects they offer are usually quite good in my inexperienced opinion but with the variety offered and the fact that with electronics every reader's level of experience is different it makes it hard to find the right balance between simple to make and in some eyes a waste of time and money to being too expensive or complicated for the average reader.
Essentially the same four or five guys design projects for Silicon Chip and while I used to subscribe to EPE I flagged it in the end because the projects they were publishing were re-hashed Silicon Chip articles that I'd already paid one subscription fee for.
I sent a letter to the editor of EPE stating exactly that and they didn't deem it fit to print.
Still, the quality of those projects is better than EFY, which I also subscribe to, and which you show up a lot in your 'Spot the Mistake' pages.
I'm not experienced enough to find mistakes as I'm nowhere near the level of 'seeing' circuits in action just by reading the schematic - part of me going to TE is to try and up-skill so that I can get to that level but I think it is something you either have or haven't - and I haven't.
Sadly in Oz and NZ if you stick your head above the parapet you can guarantee someone with no skills and no hope at all will try to shoot you down and that is a culture I cannot abide by - it keeps society in the dark ages and squashes motivation.
If you want to use anything I say as a testimonial on your site you are welcome to do so.

Kind regards --
Dave Thompson
dave@pcanytime.co.nz
Christchurch NZ

Thanks Dave,
I have had many comments from readers who have written to EPE and not received a reply.
Many readers and advertisers have commented about the re-hashed articles from Silicon Chip.
This whole interaction with EPE started when I offered 30 new projects and they were FLATLY turned down.
On further investigation I learned from an advertiser that Matt Pulzer (the editor of EPE) said he could not accept projects because "they couldn't accept them because they had no way of checking them for accuracy."
Then I find Matt Pulzer saying he will learn a lot from the basic "Teach-In" series.
The advertiser went on to say: "I don't understand why people buy the magazine when they could get the projects from Silicon Chip magazine by subscribing to that magazine instead of waiting a couple of years to see them repeated in EPE."
The second thing I want to comment on is "SEEING A PROJECT WORKING."
I have been criticized by two electronics "PROFESSORS" for making such a STUPID comment. How can a person SEE a circuit working ????
How do you think **Whitworth** SAW the wear on the teeth of his reduction-gear and work out how to reduce the wear ????
He saw the problem in his "MINDS-EYE."
To see what I mean by "seeing a project working" we just have to take the **Regulated Power Supply** circuit above.
This is reproduced from the 3rd edition of a text book that would have seen by 10,000 readers, including lecturers, teachers and students.
NOT one person could see the fault in the circuit.

When I emailed Mike Tooley, he made a vague comment about the 12v AC should be increased to 15v AC "to give the regulator headroom."
From this comment it was obvious he did not understand how the circuit worked.
That's why he did not explain it in his text book and that's why none of the readers were any the wiser. The whole discussion was a WASTE OF TIME.
Don't you think I can detect the competence of a person after teaching for over 30 years ?????
Just like I can recognise a politician after listening to 2 words, I can see if a person understands what he is talking about after a few comments.
I can see Mike Tooley has never done any soldering, never made a PC board, never made a project and never done any fault finding. He has never even looked at a 1% resistor.
If he had done any of these things he would have mentioned the tricks and traps to avoid.
He doesn't mention to use THIN solder, he doesn't mention that a 555 takes 10mA when sitting around. He doesn't mention a 555 is not an ENGINEERS chip - it is only suitable for automotive projects as it CROWBARS the power rails. His PC boards are absolutely atrocious and if any staff member made a SHIT board like his, he would be fired immediately. Even my first-year apprentice made boards I was PROUD OF.
Mike Tooley has a cheek to put himself up as an instructor. Not once does he say how the energy from a transistor stage is passed to the next stage. And he makes stupid comments about the output of a stage is 30R when the pull-down resistor is 2k. He does this because he cannot SEE a circuit working and that immediately put him in a position of not being able to teach. Or more-accurately not being ALLOWED TO TEACH.
It's no wonder Everyday Practical Electronics is going down the gurgler; like the Titanic, it is just a matter of time. The readership has plummeted in the past few years. Readers are seeing there is nothing in each issue of the magazine.
The projects are "boring" and no-one is offering kits. None of the projects are simple - for a beginner and the Forum is monitored - with negative comments removed.
Teach-In posts on the EPE Forum, have dropped from 15,000 in 2010 to 75 posts in 2011. And yet Matt Pulzer says Teach-In is one of the most popular articles in the magazine.
The global acceptance of any website is indicated by Alexia and Talking Electronics has a rating of 179,864 to represents 6,000 visitors each day. EPE has a rating of 3,044,165 and Silicon Chip is 621,393
There is no direct relationship, however the equation can be 3,000 visitors a day for Silicon Chip and 300 to 600 a day for EPE.
EPE offers nothing on their website except a JUNK soldering guide for $10.00 **WHICH HAS NOW BEEN REMOVED !!!**
If anyone has the slightest feeling that I have made an incorrect comment, please email me.
These comments are only a FRACTION of what I am REALLY feeling.
The way people have been treated by Silicon Chip and Everyday Practical Electronics is ABSOLUTELY ATROCIOUS and I can extend this to many of the text books I have downloaded.
To charge $30.00 for a text-book filled with re-hashed re-gurgitated verbiage is absolute dishonesty.
It is no wonder hundreds of visitors have said they have learnt more from my website than all the University courses they have undertaken.
The only problem is this: I have only covered the very basics of electronics.
Once you get to higher levels, mathematics takes over and faulty thinking is less evident.
No-one has covered the transistor amplifier in more details than me and after 300 circuits, I have only covered some of the circuits.
To put ONE circuit in a text book and call it COVERAGE, is beyond me. What does Mike Tooley think he is doing?????

Here's more rubbish from Mike Tooley:

Table 5.6 Characteristics of some common types of LED

Resistance (Ω)	*LED type* Miniature	*Standard*	*High efficiency*	*High intensity*
Diameter (mm)	3	5	5	5
Maximum forward current (mA)	40	30	30	30
Typical forward current (mA)	12	10	7	10
Typical forward voltage drop (V)	2.1	2.0	1.8	2.2
Maximum reverse voltage (V)	5	3	5	5
Maximum power dissipation (mW)	150	100	27	135
Peak wavelength (nm)	690	635	635	635

An LED is to be used to indicate the presence of a 21 V d.c. supply rail. If the LED has a nominal forward voltage of 2.2 V, and is rated at a current of 15 mA, determine the value of series resistor required.

Solution

Here we can use the formula:

$$R = \frac{21\text{ V} - 2.2\text{ V}}{15\text{ mA}} = \frac{18.8\text{ V}}{15\text{ mA}} = 1.25\text{ k}\Omega$$

Mike Tooleys text book has 2 pages on the LED. He does not mention the fact that the colour for each LED produces a different characteristic voltage drop across the leads.
He does not mention the cathode lead is the lead which we look for when identifying the leads and this is the shorter of the two leads and sometimes has a flat spot on the side of the LED.
In the table above what does **Resistance in Ω** mean?
How is a beginner to know the colour of a LED that produces a wavelength of 690nm ??
I have NEVER connected a LED to 21v. What a STUPID exercise.
How can the same colour LED produce different characteristic voltages of 1.8v, 2.0v and 2.2v ???
This is just JUNK information.
I have produced 20 pages on the LED and he doesn't even show a photo of a LED !!!!

Example 5.6

An NPN transistor is to be used in a regulator circuit in which a collector current of 1.5 A is to be controlled by a base current of 50 mA. What value of h_{FE} will be required?

If the device is to be operated with V_{CE} = 6 V, which transistor selected from Table 5.10 would be appropriate for this application and why?

This is another bad example. It's a very bad policy to have a transistor operating in any mode other than completely turned ON or completely turned OFF.
During both of these conditions, the transistor is dissipating the least power.

In 50 years of electronics, I have NEVER had a circuit where a transistor has 6v across the collector-emitter terminals and if you want to drop 6v @1.5amp, you use a resistor.
In a regulator circuit you NEVER use the biasing to create the output voltage. In other words, you NEVER partially turn ON a transistor to create the output voltage.
The mere fact that you are creating a regulator circuit means the output voltage is required to be stable and fixed.
This is the WORST test-question I have seen in my life.

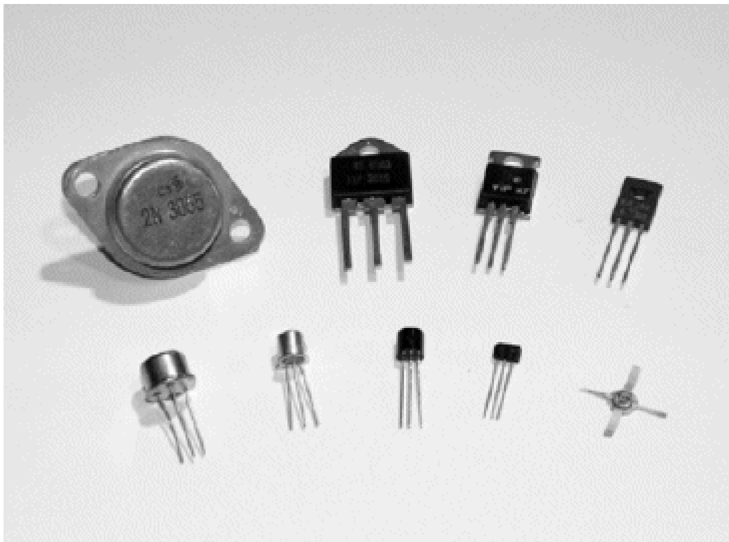


Figure 5.34 Some common transistor packages including TO3, TO220, TO5, TO18 and TO92

Which transistor is TO-218 package ??? He explains NOTHING !!!

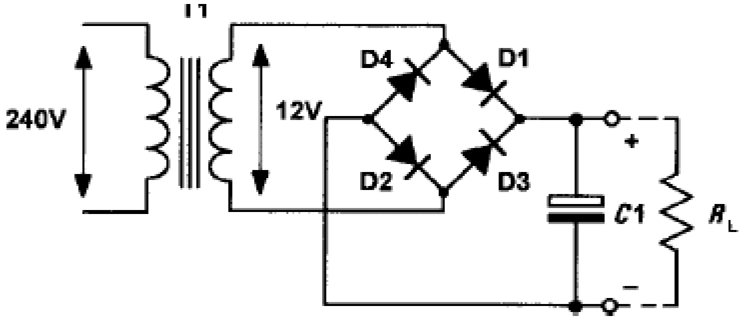


Figure 6.17 Bridge rectifier with reservoir capacitor

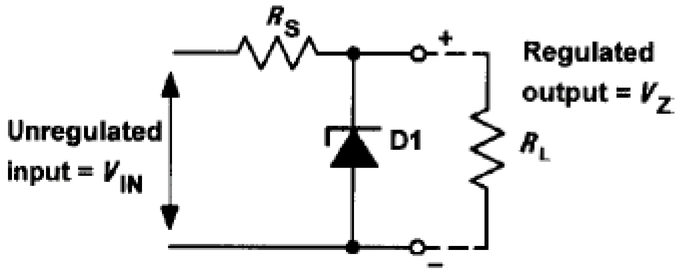


Figure 6.19 Bridge rectifier with reservoir capacitor

The caption is the same for both figures !!!

The wrong caption has not been picked up on the 3rd edition of the text book. I wonder who reads the book ???

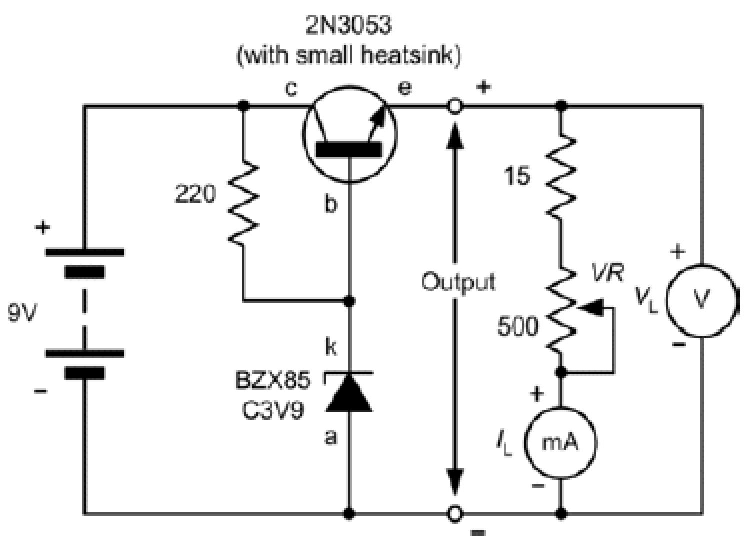


Figure 6.33 Transistor voltage regulator

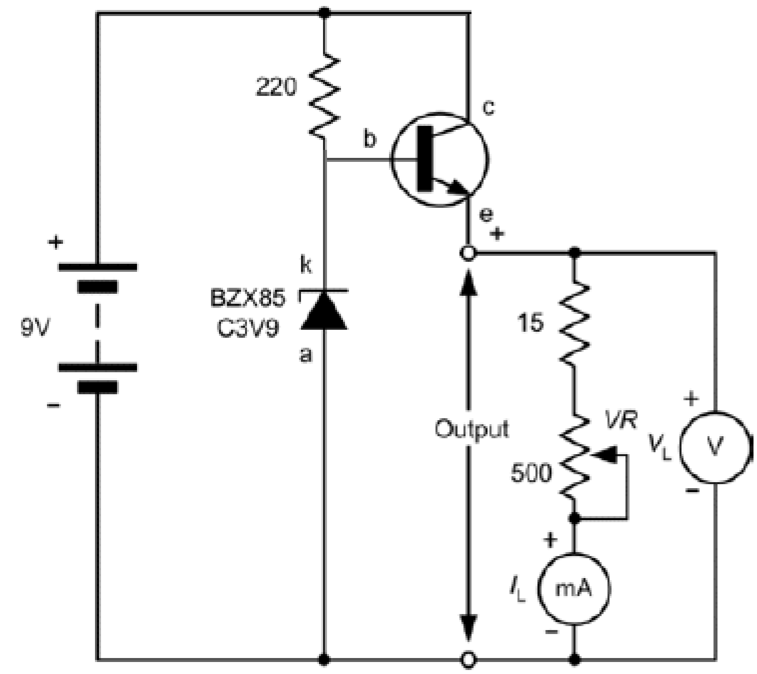


Figure 6.33 Transistor voltage regulator

The diagram shows a transistor regulator. It's no wonder the student can't learn anything from the text book. I don't know how the circuit works until I change it to show the transistor operating as an EMITTER-FOLLOWER. Now I can see the emitter will be 0.7v less than the base.
The gain of the transistor can vary from 25 to 250, depending on the collector current.
The data sheet is vague and lacking any graphs to help with determining its suitability for this circuit.
However the transistor is effectively reducing the 220R resistor by 220 (the gain of the transistor) and thus the transistor becomes equal to a 1 ohm resistor for the highest gain and equal to 9 ohm for the lowest gain.
This is just a quick, mental, way of assessing how the circuit will behave with a 15R load and how you can see the circuit as a VOLTAGE DIVIDER.
These are the personal points Mike Tooley should be including in the text.
If you connect 9R and 15R in series, you will get more than 6v at the join and thus the circuit will work as required.

Bias

We stated earlier that the optimum value of bias for a Class A (linear) amplifier is that value which ensures that the active devices are operated at the midpoint of their transfer characteristics. In practice, this means that a static value of collector current will flow even when there is no signal present. Furthermore, the collector current will flow throughout the complete cycle of an input signal (i.e. conduction will take place over an angle of 360°). At no stage will the transistor be **saturated** nor should it be **cut-off** (i.e. the state in which *no* collector current flows).

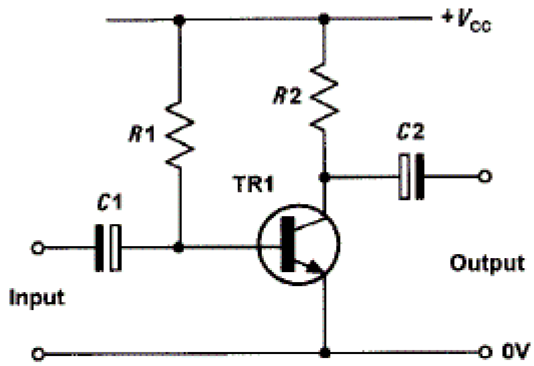


Figure 7.31 Basic Class-A common-emitter amplifier

The explanation is just gobbeldy-gook.

This type of class-A amplifier is unsuitable or audio because it is very difficult to get the collector voltage to sit at half-rail.
The gain of the transistor, the temperature of the day and the rail voltage will alter the operating point and make the amplifier unreliable.
It's pointless covering this circuit however the explanation in the text is very poor.
The operating point can be obtained by selection high values of resistance for the base and load. This is called light biasing the transistor.
The values can be lowered and this is called medium biasing the transistor.
The values can be smaller and this is called heavily biasing the transistor.
The values must be chosen so the current entering the base via the capacitor will no cause the voltage on the collector to rise to rail voltage or drop to nearly 0v.

Look at this RUBBISH:

	Capacitor type			
	Ceramic	*Electrolytic*	*Polyester*	*Mica*
Capacitance range (F)	2.2 p to 100 n	100 n to 10 m	10 n to 2.2 μ	0.47 to 22 k
Typical tolerance (%)	±10 and ±20	−10 to +50	±10	±1
Typical voltage rating (W)	50 V to 200 V	6.3 V to 400 V	100 V to 400 V	350 V

What does this mean: 100 n to 10m should be: 100 n to 10u
What does this mean: 0.47 to 22k should be: 0.47u to 22n
What does this mean: Typical voltage rating (W) should be Typical voltage rating (V)

More RUBBISH:

Table 2.6 Characteristics of common types of inductor

Property	*Inductor type*	
	Air cored	*Ferrite cored*
Core material	Air	Ferrite rod
Inductance range (H)	50 n to 100 μ	10 μ to 1 m
Typical d.c. resistance (Ω)	0.05 to 5	0.1 to 10
Typical tolerance (%)	±5	±10
Typical Q-factor	60	80
Typical frequency range (Hz)	1 M to 500 M	100 k to 100 M

All values MUST show the full nH, R or MHz

Table 2.6 Characteristics of common types of inductor

Property	*Inductor type*	
	Air cored	*Ferrite cored*
Core material	Air	Ferrite rod
Inductance range (H)	50nH to 100 μH	10 μH to 1 mH
Typical d.c. resistance (Ω)	0.05R to 5R	0.1R to 10R
Typical tolerance (%)	±5	±10
Typical Q-factor	60	80
Typical frequency range (Hz)	1 MHz to 500 MHz	100 kHz to 100 MHz

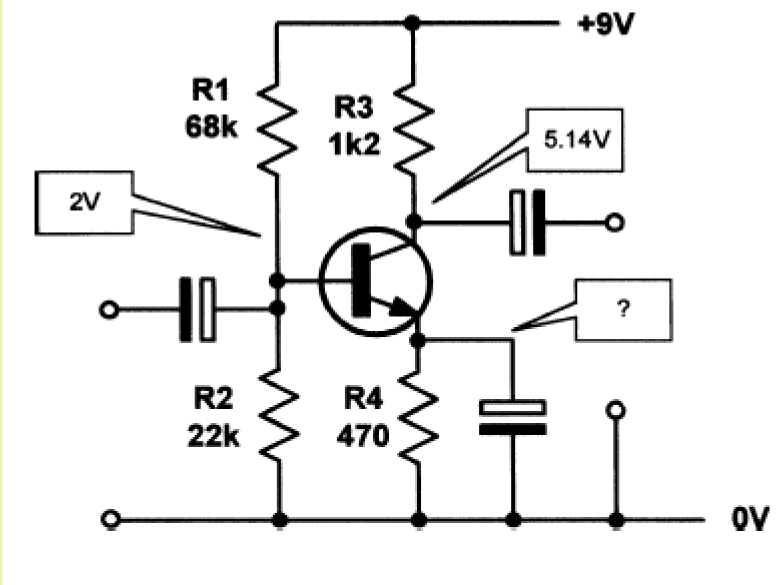


Figure A2.19 See Question 39

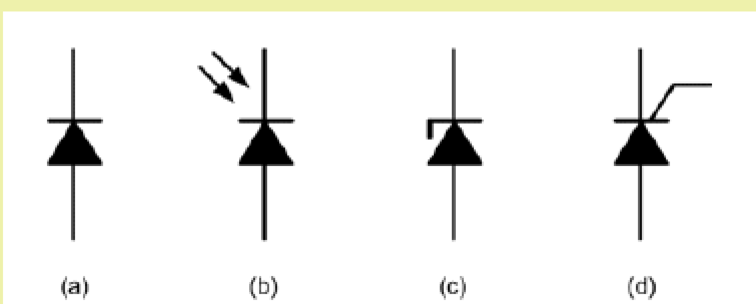
The first mistake is stating a voltage to two decimal places when the resistors are either 5% or 10%.
A 10% resistor can be 10% higher or lower than the stated value and this is a gap of 20%. When you get two or more resistors, the deviation increases 2, 3 or 4 fold.
No collector voltage will remain steady to a factor of 1/100th of one percent.
All data should be referenced to the component(s) having the worst tolerance.
The collector current is 3.2mA and the emitter current will be about the same.
This is not a high current and we can assume the transistor has a gain of 100 or more. This means the base-emitter voltage will be about 0.7v and the emitter voltage will be 1.3v.

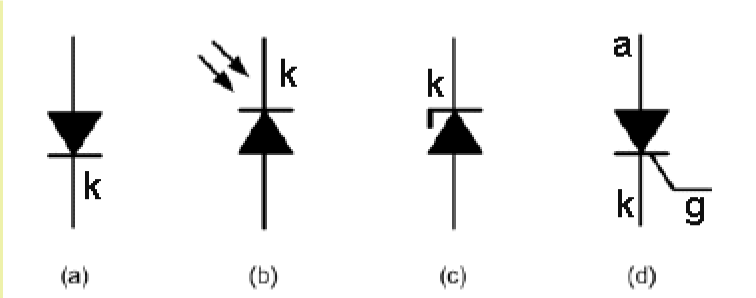
Table 5.8 Classes of transistor

Classification	*Typical applications*
Low-frequency	Transistors designed specifically for audio and low-frequency linear applications (below 100 kHz)

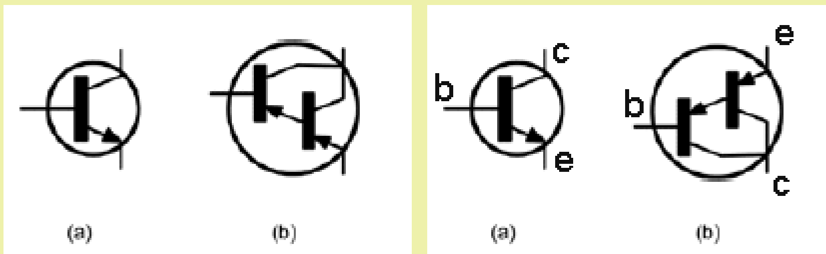
This is just RUBBISH. It sounds like there is a whole range of transistors designed for operation below 100kHz. All transistors will operate at a low frequency. This is just a STUPID thing to say.

Components should be drawn in the same position they will be placed in a circuit, with an imaginary positive rail at the top. This is just another INTELLIGENT thing to do to help the beginner. And they should be labelled.





The diode and SCR have been drawn as they would appear in a circuit



The transistor has been flipped over

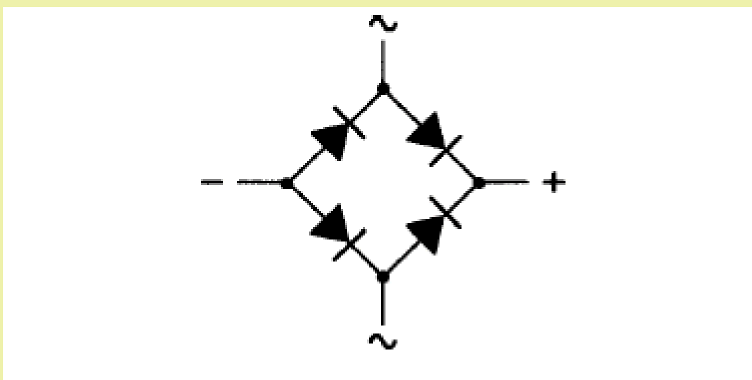


Figure 6.14 Four diodes connected as a bridge

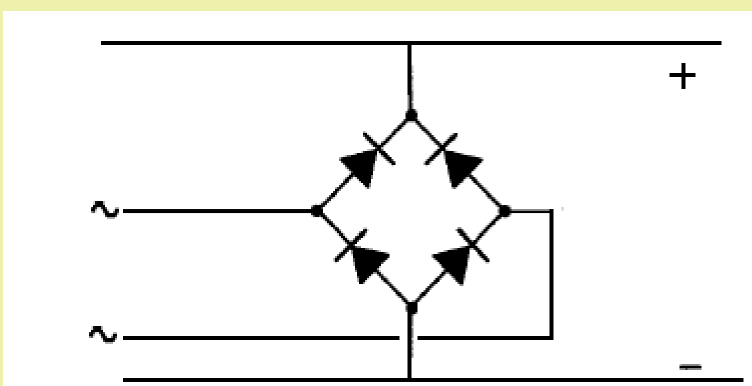
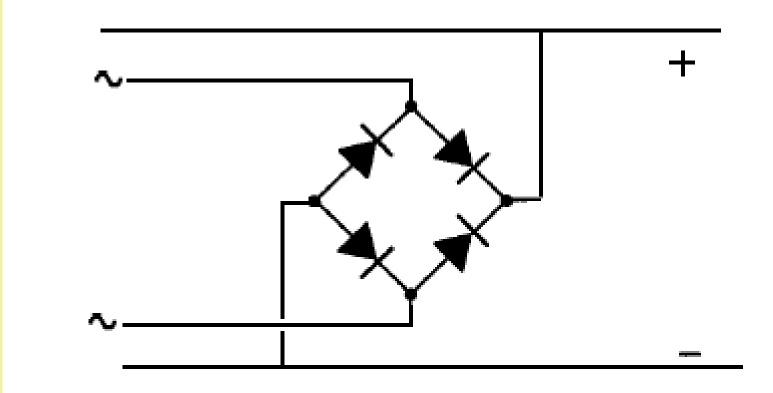
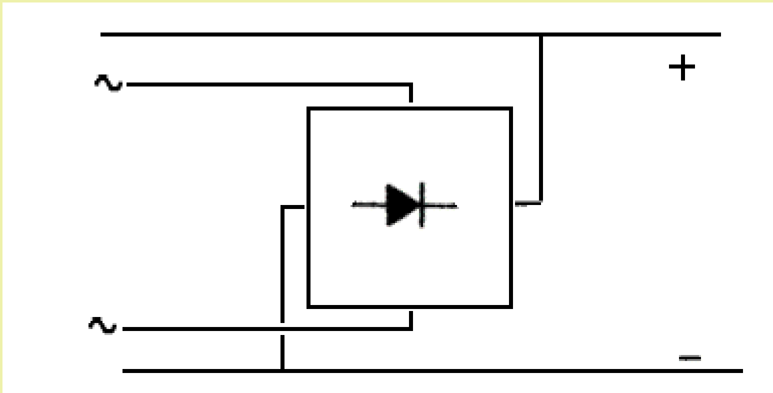


Figure 6.14 Four diodes connected as a bridge

This diagram shows the input and output of the bridge



I like this layout because you can see the diodes all face one direction



The bridge can be replaced with a box and a single diode showing the direction.
The box can be a diamond

Table 1.1 Selected data for some popular bipolar junction transistors

Device	Type	I_C max.	V_{CE} max.	P_{tot} max.	h_{FE} at I_C	Package	Typical application
2N3906	PNP	200mA	40V	625mW	150 at 2mA	TO92	General purpose
2N4919	PNP	1A	80V	30W	10 at 1A	TO225	General purpose driver
2N4923	NPN	3A	80V	30W	50 at 500mA	TO126	General purpose power
BC337	NPN	800mA	50V	625mW	300 at 100mA	TO02	Driver and low power output
BC548	NPN	100mA	30V	500mW	250 at 2mA	TO92	General purpose amplifier
BC558	PNP	100mA	30V	500mW	250 at 2mA	TO92	General purpose amplifier
BC560	PNP	100mA	45V	500mW	250 at 2mA	TO92	Low noise amplifier
TIP32	PNP	3A	80V	40W	50 at 1A	TO220	Power amplifier

Table 1.1 Selected data for some popular bipolar junction transistors

Device	Type	I_C max.	V_{CE} max.	P_{tot} max.	h_{FE} at I_C	Package	Typical application
2N3906	PNP	200mA	40V	625mW	150 at 2mA	TO92	General purpose
2N4919	PNP	3A	60v	30W	30 at 1A	TO225	General purpose driver
2N4923	NPN	3A	80V	30W	30 at 1A	TO126	General purpose power
BC337	NPN	800mA	50V	625mW	300 at 100mA	TO02	Driver and low power output
BC548	NPN	100mA	30V	500mW	250 at 2mA	TO92	General purpose amplifier
BC558	PNP	100mA	30V	500mW	250 at 2mA	TO92	General purpose amplifier
BC560	PNP	100mA	45V	500mW	250 at 2mA	TO92	Low noise amplifier
TIP31	NPN	3A	80V	40W	50 at 1A	TO220	Power amplifier
TIP32	PNP	3A	80V	40W	50 at 1A	TO220	Power amplifier

All these transistors are very cheap on eBay (25% of normal price) with free postage. TIP31 has been added for TIP31/32 push-pull output. (5 x TIP31/32 pairs for $3.00 posted)

Look at this stupid diagram:

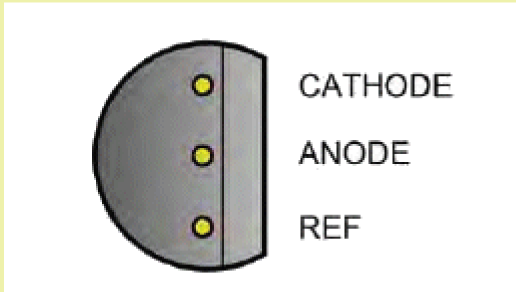


Fig.5. Connection details for the TL431C regulator. Note that this is a top view and not a transistor-style base view

It is a TOP VIEW !!!!
Show me a regulator with leads coming out the top of the device !!!!
That's why I provide a full 3D sketch of the device, so you don't have to try and work out how it is connected.

Here is another poor diagram and the improved labeling shown in the second diagram:

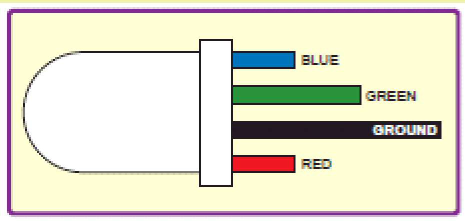
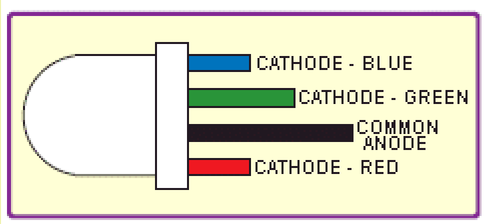
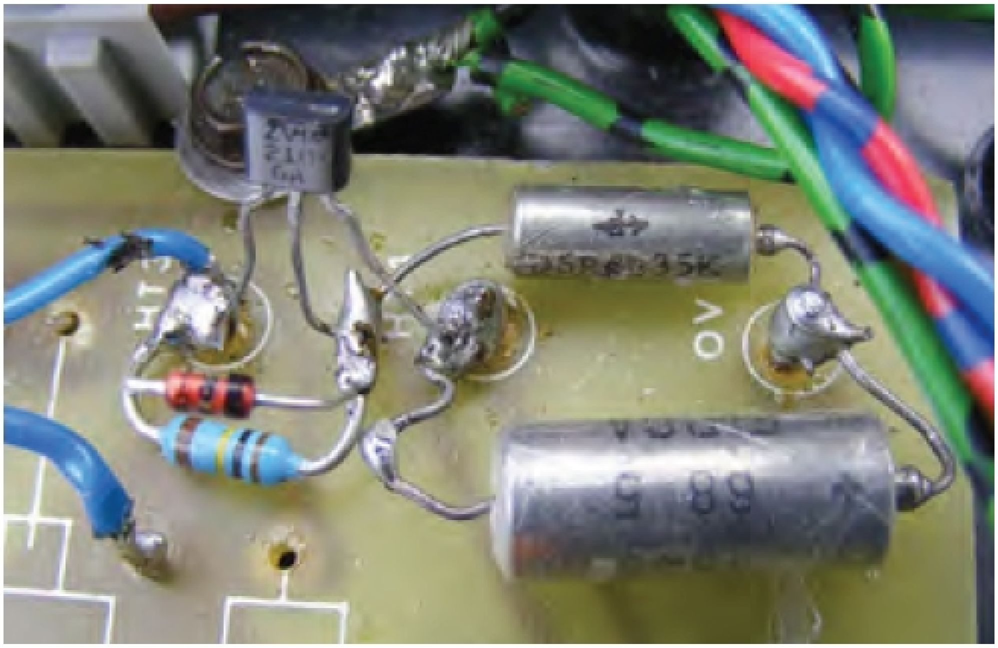


Fig.4 Typical RGB LED pin-out

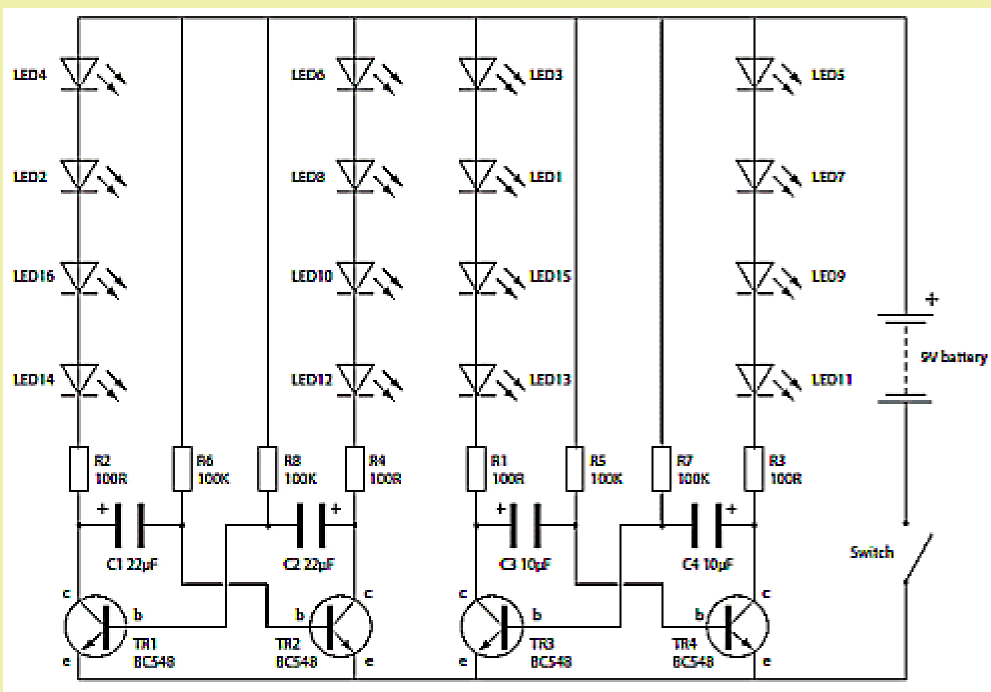


Here is a "professional" solution to fixing a problem:

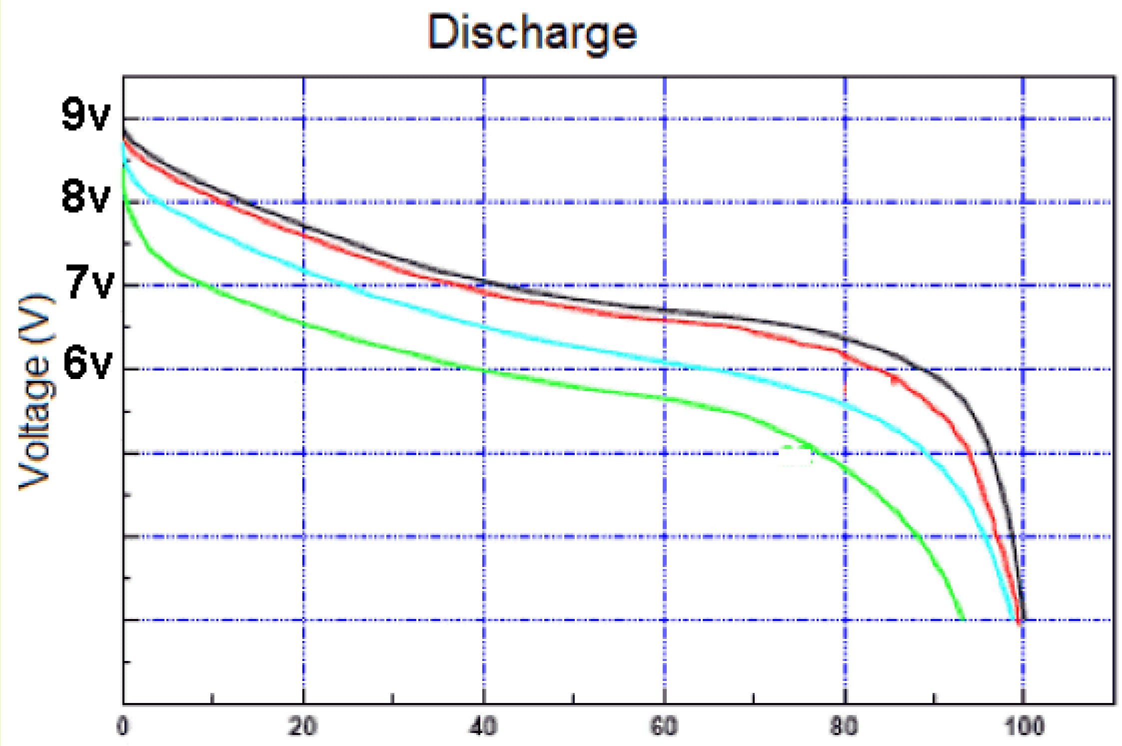


Look at the soldering and the parts-placement. This is NOT the sort of picture to print in an electronics magazine. What an embarrassment.

Here is a **Flashing Christmas Tree** circuit from Tandy:



It has one major FAULT. The 4 LEDs in series will produce a characteristic voltage drop of 1.7v x 4 = 6.8v and the voltage drop across the collector-emitter of the driver transistor is 200mV. This means the minimum supply MUST BE 7v. There will be a small voltage drop across the 100R resistors (between 2v and less than 100mV). The voltage of a 9v battery drops very quickly when with a current of 10mA and the circuit will stop working when the voltage reaches 7v. This represents only about 40% of the life of the battery.
This is something to remember when designing a circuit.



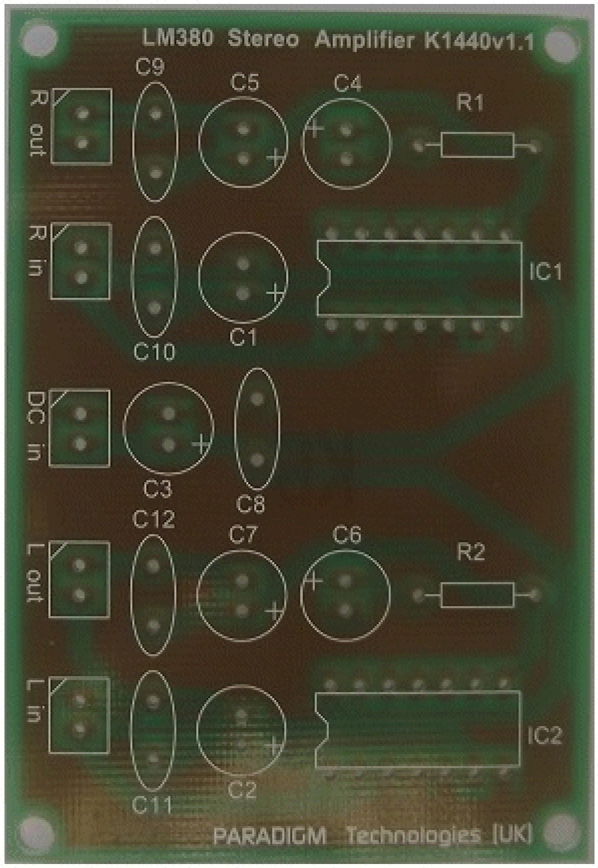
Here's some junk audio amplifiers from:

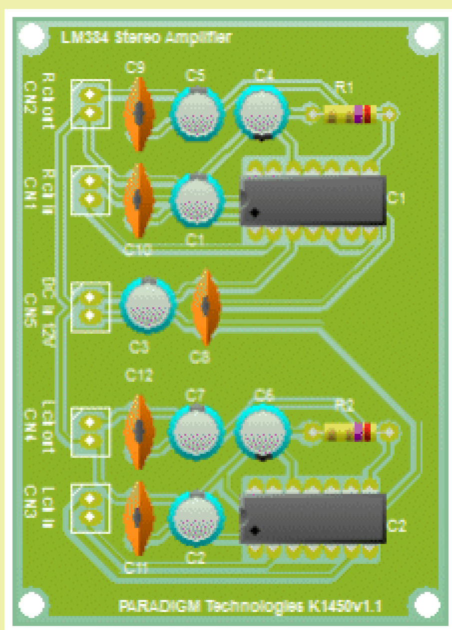
PARADIGM Technologies (UK) LT

Registered office address:
64 Blacksmith Close, Oakdale, Blackwood, Gwent, Wales, NP12 0BG
Company status: Dissolved on 29 December 2015
Fortunately this company has GONE!!!!

Paradigm Technologies has over 35 years of experience in the electronic industry with an extensive portfolio including test development, embedded system design and digital signal processing. They have created many successful products during this time.
Paradigm Technologies range of kits will use the latest technologies from areas such as audio, solar, computing, displays, energy harvesting, battery/storage devices and wireless communication.
Paradigm Technologies have launched their initial range of electronic kits, with many further kit and module releases planned for 2014.

Their range of amplifiers include LM380 and LM384.
Here are some of the PC boards:





The range of LMxxx amplifier chips absorb about 2 to 5 watts and MORE from the supply and deliver some of this power to the speaker. However, some of the wattage is produced by the components in the chip and this increases the temperature of the IC.
The 3 middle pins on each side of the LM380 and all the pins down one side of the LM384 are connected to the output transistors inside the chip in the form of a HEATSINK and although they are not electrically connected, they take away the heat generated by the devices.
BUT the pins MUST be soldered to the copper laminate of the PC board so the heat will be transferred to the board and passed to the surroundings.
The heat generated by the IC can be 2 watts or more and this requires at least 30 square cm of copper to prevent the IC overheating.
Ideally, the copper needs to be thicker than the normal copper laminate but this can be done by tinning the board.

If you look at the boards designed by **"Paradigm"** you will see NO heatsink provided by the board.
Paradigm Technologies has over 35 years of experience in the electronic industry - what have they been doing????
They have absolutely NO IDEA how to design an amplifier.
Simply connect the amplifier to an oscillator and listen to the response from a speaker. Put your finger on the chip and see how hot is gets.
The LM380 is a 2.5 watt chip and they say it is 4.1 watts!!
Paradigm was emailed with this information and they have NOT REPLIED !!!
They are trying to sell their faulty LM380 stereo amplifier kit for $30.00 You can by 3watt+ 3watt on eBay for $1.00 posted !!! PAM8403 Audio Stereo Amplifier Board Class D Kit Module 2*3W USB Power

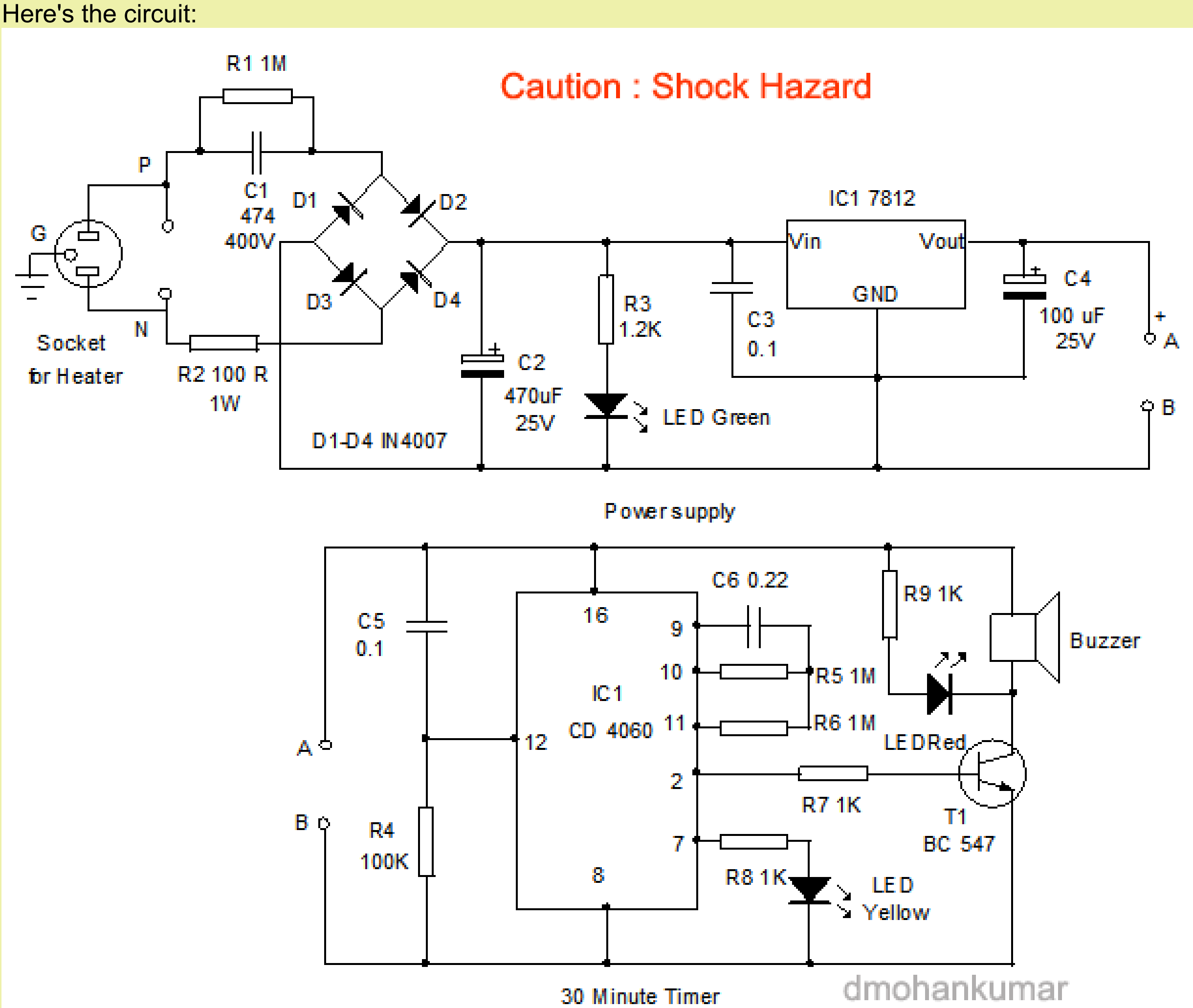
All kits are available from our official UK Distributor:
ESR Electronic Components Ltd. www.esr.co.uk

The distributor was also notified and did not reply. Obviously he did not understand the concept of heatsinking an audio amplifier and he will become "unglued" when a customer asks for a refund on a faulty design.
I am not "stirring the pot." The kits are absolute RUBBISH and provide NO HEATSINKING. They simply will not work.
I don't mind losing $1.00 on a Chinese kit but $30.00 plus TAX and delivery on a faulty project is annoying.

I checked the web for Paradigm Technologies (UK) Ltd on 1st July 2016. They have "GONE."
Paradigm Technologies (UK) Ltd was registered on 19 May 2014 with its registered office in Gwent. The business has a status listed as "Dissolved."

Water Heater Alarm

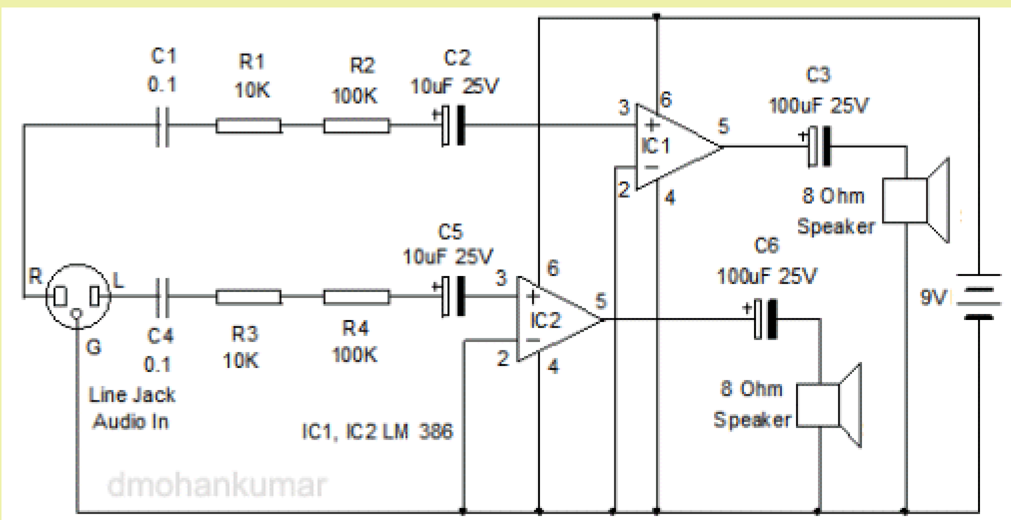
Here is an unusual circuit using a capacitor-fed power supply. The circuit is badly designed and comes from a long list of poorly designed circuits by Professor D.Mohankumar.
He does not understand the concept of how a transformerless power supply works because it is very complex.
Here's the circuit:



A transformerless power supply delivers 7mA for each 100n of capacitor C1. Thus 474 delivers 33mA.
This current NEVER changes and the output voltage of the supply depends on the resistance of the load.
In other words, the output voltage will rise until the current through the load is 33mA.
This concept is entirely different to any other power supply and that's why you have to understand it.
The LM 7812 regulator takes between 5mA and 8mA and although this is not important in a normal power supply, it makes a big difference in our circuit.
Suppose it takes 8mA. This leaves 25mA. Suppose the timing circuit takes 1mA, this leaves 24mA.
This means the voltage on the regulator will rise to 30v and the 1k2 resistor will take 24mA. This means 24mA will flow through the LED.
This voltage is more than the 25v allowable for the 470u electrolytic.
If the regulator takes 5mA, the situation is worse. 28mA will be available for the 1k2 and the voltage across this resistor will be 35v.
When the timing circuit turns ON, the current through the 1k base resistor will be 12mA. The transistor does not need this high current, however the current is "robbed" from the LED and the 12mA flows through the regulator to the chip and out the 1k resistor. The input voltage on the regulator drops from 30v to 18v. Or 35v to 21v if the regulator takes 5mA.
When the transistor turns ON, the LED on the collector turns ON and another 12mA flows through the LED. This drops the input voltage to the regulator by 12v as it is robbing the current from the 1k2 resistor. Suddenly we don't have 12v available from the power supply because the input voltage to the regulator would drop to 6v or 9v.
We now have an unknown set of conditions where ALL the available current has been taken by components and NOTHING is available for the Buzzer. All the voltages will drop and some current will be available for the buzzer but it will only be a few mA.
This is just another MESSY design by the Professor who does not check or test ANYTHING.

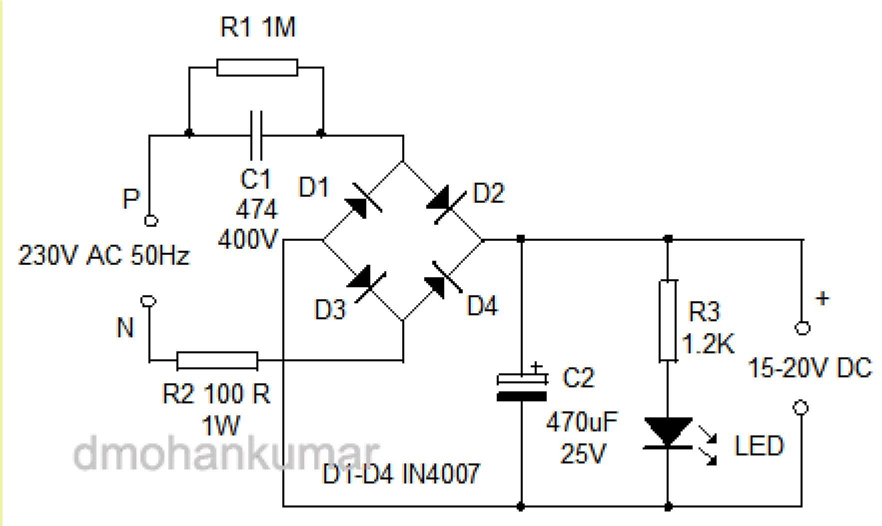
Here is another STUPID circuit from Professor D.Mohankumar.

What is the purpose of the 10u electrolytic when the input capacitor is 100n ??
What is the purpose of the 10k on the input when 100k is in series ???

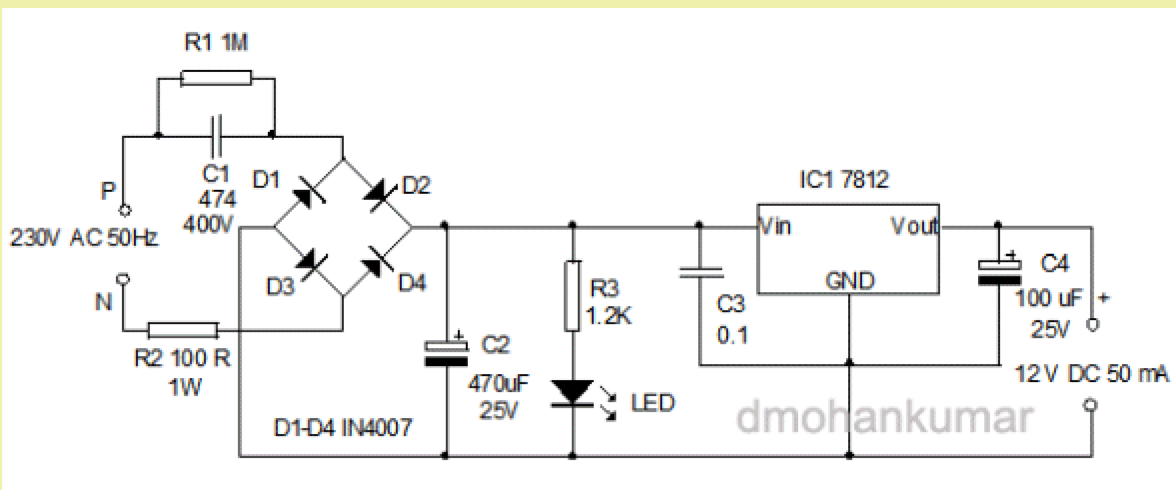


Just another stupid circuit from the Professor who does not check or test ANYTHING.
And he says I cannot "see" a circuit working. I can "see" these 4 components are NOT NEEDED.

Here is another STUPID circuit from Professor D.Mohankumar.

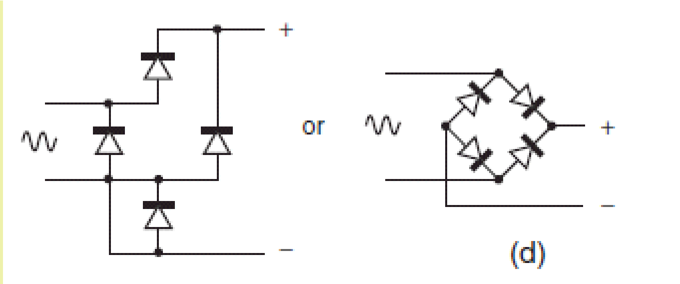


If the load is removed from the circuit above, the output voltage will rise to
Here's why:
The 474 capacitor will deliver 7mA for each 100n = 33mA. The voltage across the 1k2 resistor will be:
V = I x R = 0.033 x 1,200 = 39 volts. The 25v electrolytic will BLOW UP.
The wattage of the 100R resistor needs to be I^2 x R = 0.033 x 0.033 x100 = 0.1 watt NOT 1 WATT !!!

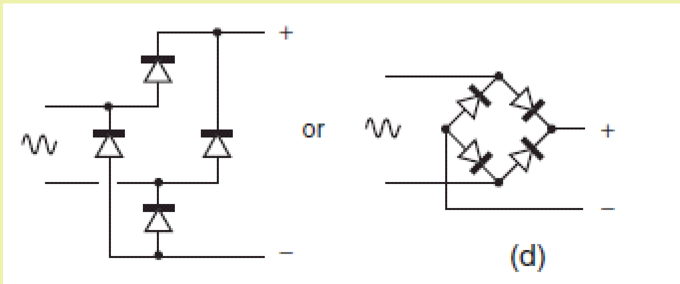


The 474 capacitor will deliver 33mA.
The 7812 regulator requires 8mA. This leaves 25mA.
The voltage on the output of the bridge will rise to 30v until 25mA is taken by the 1k2 resistor.
This will leave NOTHING for the output of the circuit.
If you draw 13mA, the voltage on the input of the regulator will drop to 14v and the regulator will start to drop out of regulation.
This circuit has obviously NEVER been tested. It can NEVER deliver 50mA.
It is just another JUNK circuit from **Professor D.Mohankumar.**

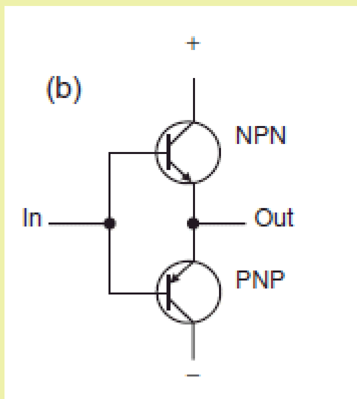
Look at this mistake in PRACTICAL ELECTRONICS HANDBOOK



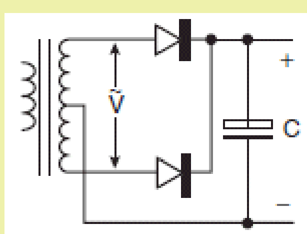
The input wires do not connect to the diode



The corrected bridge circuit



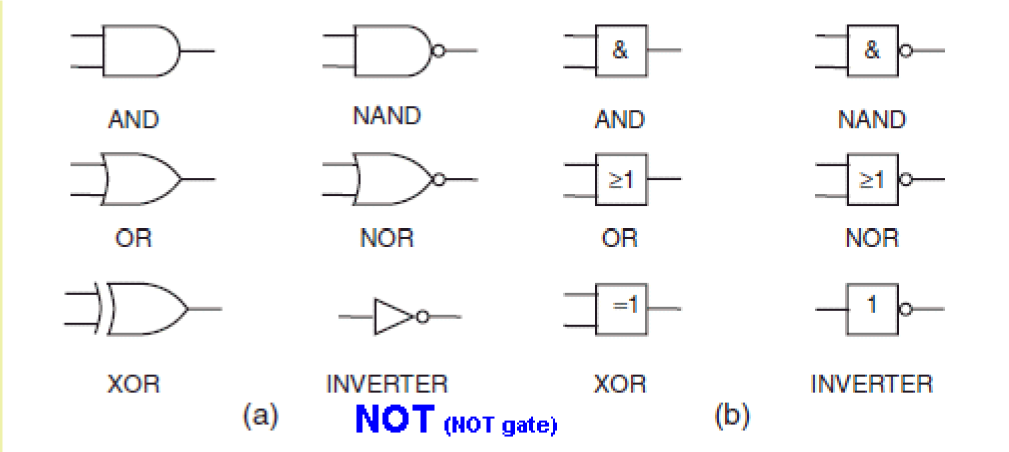
Here's some DRIVEL about the circuit above: The author says: using a complementary emitter-follower output circuit with no load resistor.
What does that mean ???
He then says: a complementary double-emitter-follower circuit which uses transistors both to charge and to discharge stray capacitances.
What RUBBISH !!! How is a beginner going to learn anything about electronics when this sort of rubbish is presented in text books.
This drivel comes from Ian Sinclair and John Dunton.
The circuit is a COMPLEMENTARY-SYMMETRY PUSH-PULL OUTPUT. It is effectively an emitter-follower in BOTH DIRECTIONS and has a very low output impedance. The circuit will drive an 8R speaker directly or via a 100u electrolytic. If the gain of the transistor is 100,this will make the input impedance about 1k.
Go to The Transistor Amplifier to learn more about this circuit.



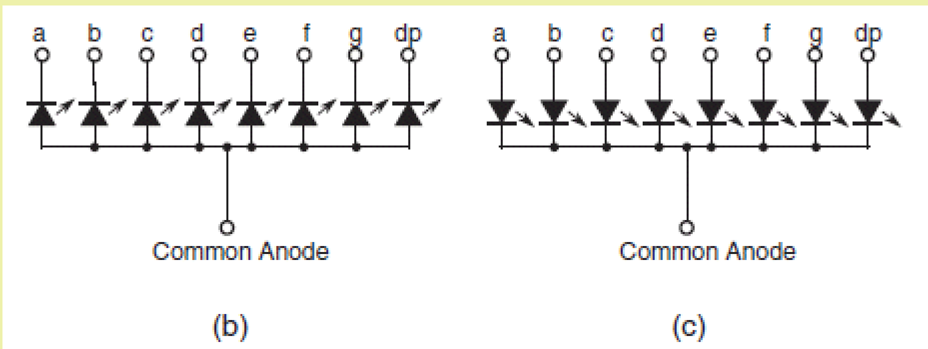
(b) biphase half wave,

This is NOT a half-wave supply. It is a BI-PHASE FULL-WAVE POWER SUPPLY.

Neither Ian Sinclair or John Dunton have never done any Logic Designs. They have forgotten to say the Inverter is a NOT gate !!!



They both cannot be common anode:



The whole text book is just a jumble of topics where nothing is really covered fully and not a single item is covered in enough detail for the student to say he has learnt anything.
Everything in the text book is freely available on the web in MORE detail and I wouldn't waste any more time looking though the book after downloading it from the link above. It doesn't even rate a score of 1 out of 5.
It's absolutely pointless being **all things to all men.**
Trying to cover so many topics with such little information is a COMPLETE WASTE OF TIME.
I couldn't find many mistakes in the book because there was little factual material. Everything had been lifted from other text books or lists of pointless information - to fill the pages. The photos were all taken from the web and were the poorest quality possible. All the diagrams came from different sources and used different symbols.
It's really just a JUNK text book. Just add the .pdf to your computer, look through it, and don't waste any more time. For these simple mistakes to be present in the 6th edition, indicates its value as a text book.

Here's more RUBBISH from Professor D.Mohankumar.

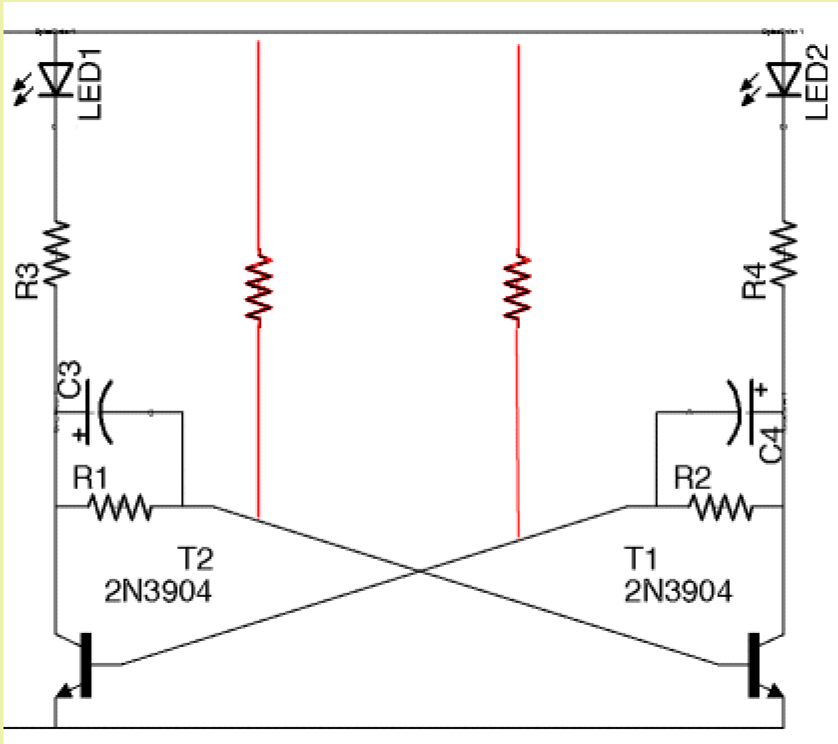
Wattage is the capacity of the resistor to handle maximum current. Usually, ¼ watt resistor is used if the current in the circuit is less than 50 milliamps.

Resistor wattage	Maximum allowable current
¼ Watt	50 mA

Wattage is the capacity of the resistor to handle maximum current. This is NOT TRUE
Wattage is the voltage across a resistor MULTIPLIED by the current flowing through the resistor.
When the resistance is SMALL, the current can be HIGH.
Take the following examples:
For a 1R resistor, the current can be 250mA - the resistor can act like a fuse
For a 5R resistor, the current can be 225mA - the resistor can act like a fuse
For a 10R resistor, the current can be 160mA - the resistor can act like a fuse
For a 22R resistor, the current can be 100mA - the resistor can act like a fuse
For a 100R resistor, the current can be 50mA

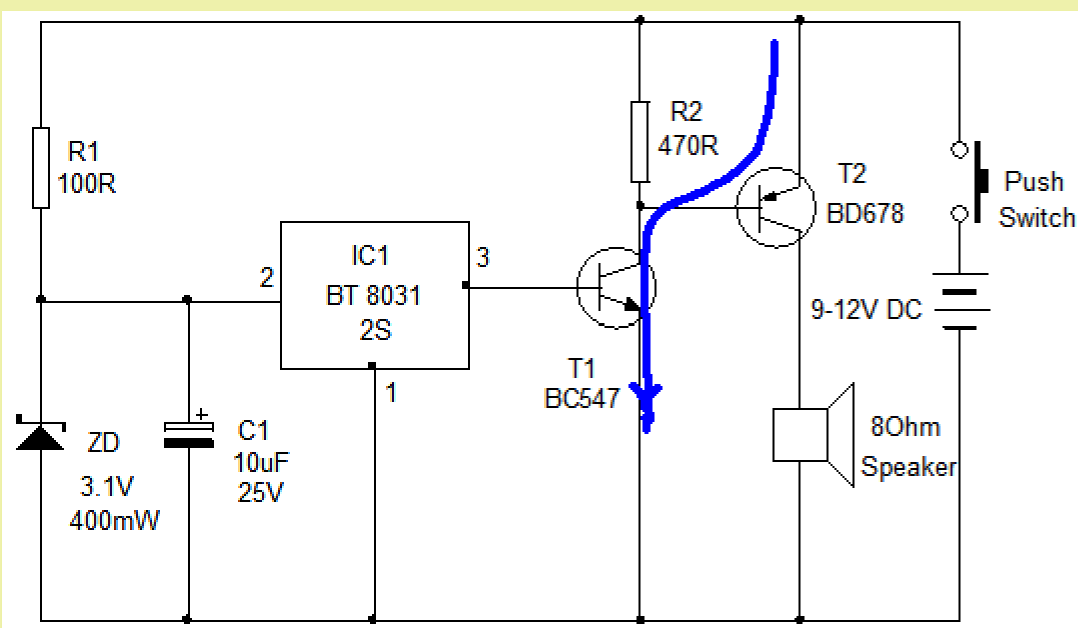
It will burn out when excess current flows

Here's a circuit from a reader who wanted me to help him create a PCB:



Before you create a PC board for a circuit, make sure the project WORKS !!
The circuit does NOT work. When one transistor is turned ON, the collector voltage is almost zero and the resistor and electrolytic are connected to 0v. There is no resistor connected to a voltage that will start to charge the electrolytic and continue the cycle.
The two black resistors need to be removed and replaced with the two red resistors.
The circuit will now FLIP FLOP !!!!

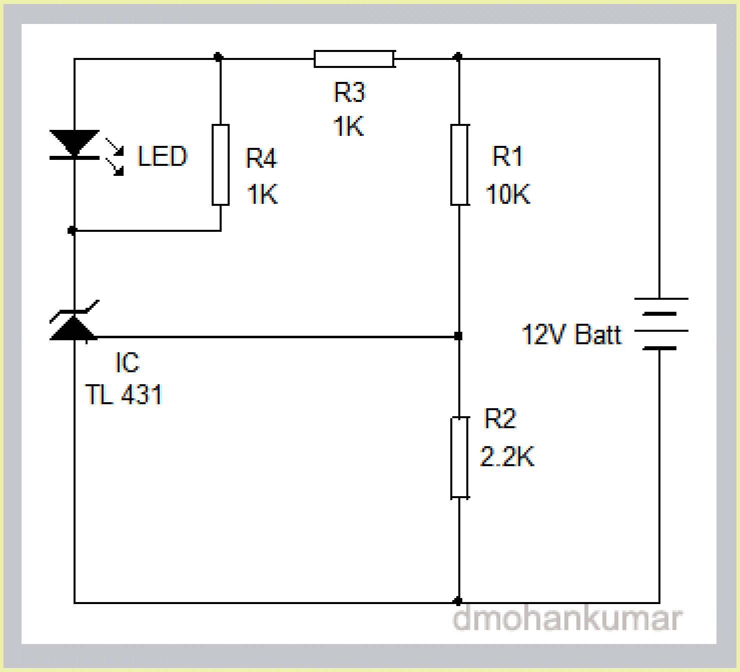
MELODY CIRCUIT



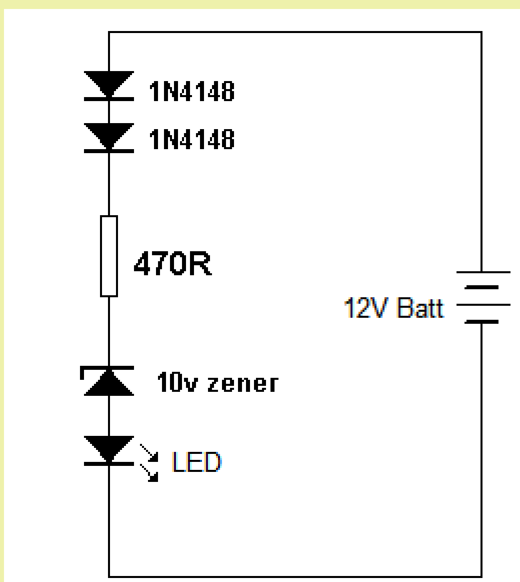
When the switch is pressed, the BC547 transistor will get turned ON and a high current will flow in the collector-emitter junction. This current will not be limited by the 470R resistor because the BD 678 transistor is directly connected between the collector and positive rail.
This transistor only produces a 0.7v drop across the emitter-base junction and a very large current will flow though this junction.

Either or both transistor can be destroyed if a current-limiting resistor is not fitted.

BATTERY MONITOR

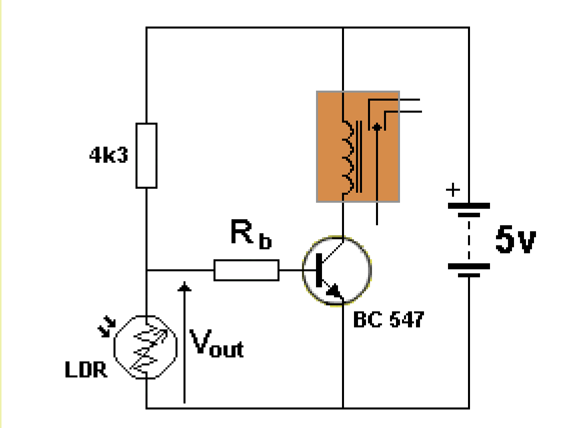


The circuit shows a 12 volt battery monitor circuit using TL431 Shunt regulator. It lights a Green LED when the voltage of the battery rises above 12 volts. Let us select the High limit as 13.8 volts which the voltage of a 12 volt Lead Acid battery after fully charged.



The circuit can be simplified to a 10v zener and dropper resistor. The 1N4148 diodes increase the detection-point by 0.7v for each diode. You don't have to use an expensive, hard-to-get, TL431 device.

Here is a good example of how to analyse a circuit.



Homework questions:
1. Calculate the resistance of the LDR (Light Dependent Resistor) when Vout is 0.4v.
When light shines on the LDR, its resistance reduces and the voltage across it decreases. When the voltage across it is 0.4v, the transistor will not be turned on and we can consider the transistor, relay and Rb to be removed from the circuit.
This means we have only two components, the 4k3 and LDR forming a voltage divider.
Here are the things we know: the supply is 5v, the resistor is 4k3, the voltage across the LDR is 0.4v and the current through the 4k3 and LDR will be the same.
If we work out the current through the resistor, we know the current through the LDR and the voltage across it is 0.4v.
The voltage across the 4k3 is 5v - 0.4 = 4.6v
The current through the 4k3 = 4.6/4300 = 0.00107Amp
The resistance of the LDR = 0.4/ 0.00107 ohms = 374 ohms

2. Calculate the base current when Vout is 3.2v and Rb is 1k5.

This is where a mistake is introduced.
Before we answer the question, here is the way to look at the circuit.
Remove the LDR and the circuit consists of 4k3, 1k5 and the voltage of 0.6v across the base-emitter junction.
This means the circuit can be seen as 4k and 1k across a 5v rail.
This means one volt will be dropped across each 1k or resistance.
This means approx 4v will be dropped across the 4k3.
And looking at the 1k5 and base-emitter voltage, the voltage will be about 1.5v plus 0.6v = 2v.

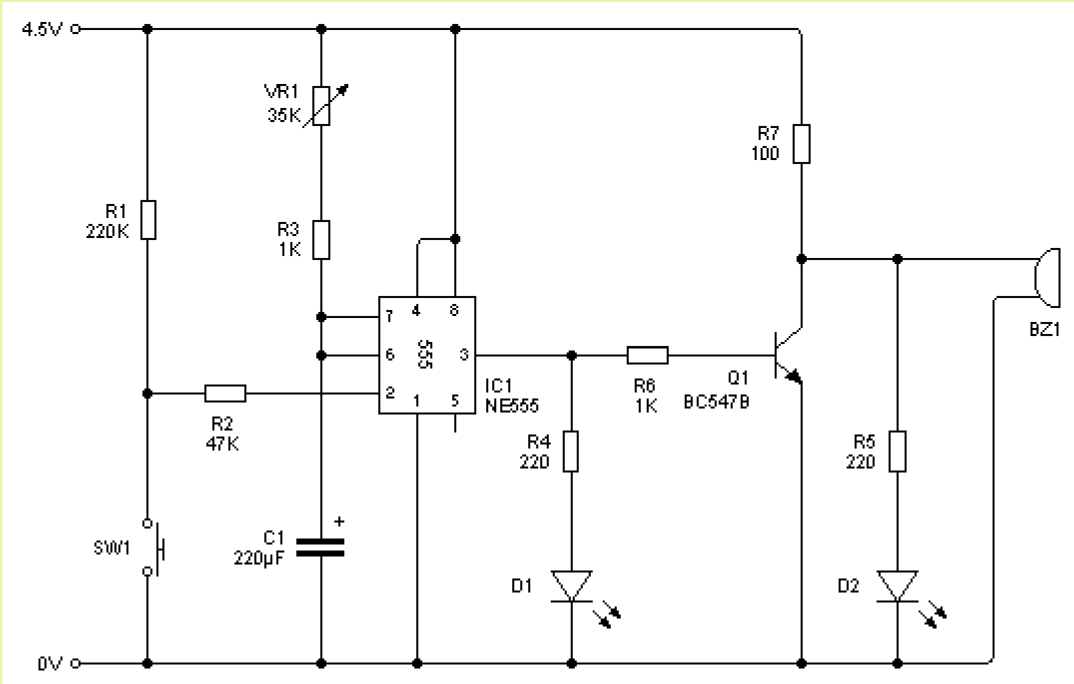
Now we go back to question 2. The voltage at the join of the 4k3 and 1k5 resistors WILL NEVER be higher than about 2v, so the question is FALSE.

When the LDR is NOT ILLUMINATED, its resistance is very high and we will assume it is so high that it is equivalent to being removed from the circuit.
This will allow us to work out the maximum current into the base of the transistor.
Here are the values we use: the voltage across the 4k3 and 1k5 = 5v - 0.6v = 4.4v The total resistance = 4.3 + 1.5 = 5k8
The maximum current is: 4.4 / 5800 = 0.75mA.
If the transistor has a gain of 150, the collector current can be as high as 100mA. This is sufficient to activate a sensitive relay.

Did you spot the mistake in the second question?
The voltage of 3.2v is the voltage ACROSS the 4k3 resistor and NOT the voltage at the join of the 4k3 and 1k5
The voltage across the 4k3 is determined by:
The total resistance = (4k3 + 1k5) = 5.8v
The voltage across this combination is: 5v - 0.6v = 4.4v
The voltage across the 4k3 = 4.4/5.8 x 4.3 = 3.2v This is the voltage ACROSS THE RESISTOR.

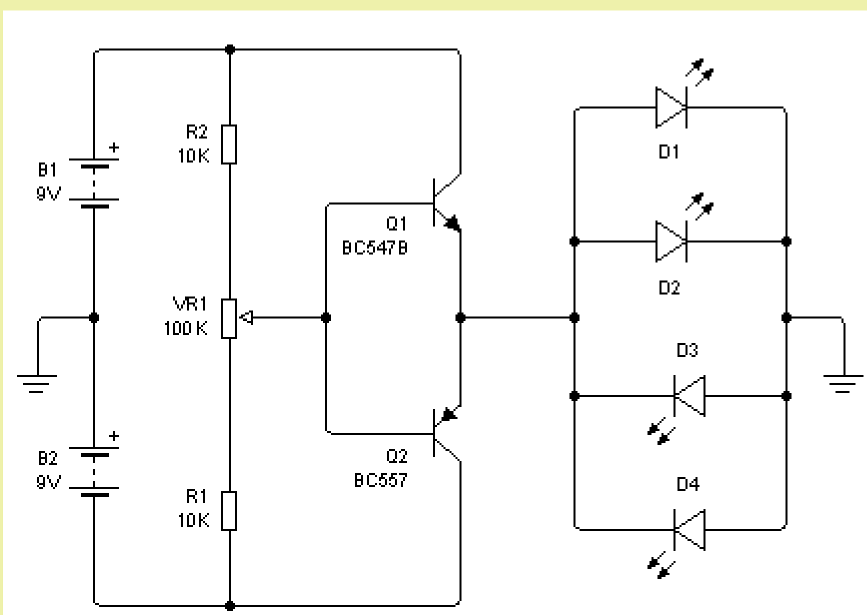
That's why you must WORK OUTSIDE THE BOX. This means looking at a question in a very simple way and calculate the approximate values BEFORE using any formulae.
This will prevent you making any silly mistakes and and show-up your instructor as being HIGHLY INTELLIGENT or ABSOLUTELY STUPID.

There are three mistakes with this EGG TIMER circuit:



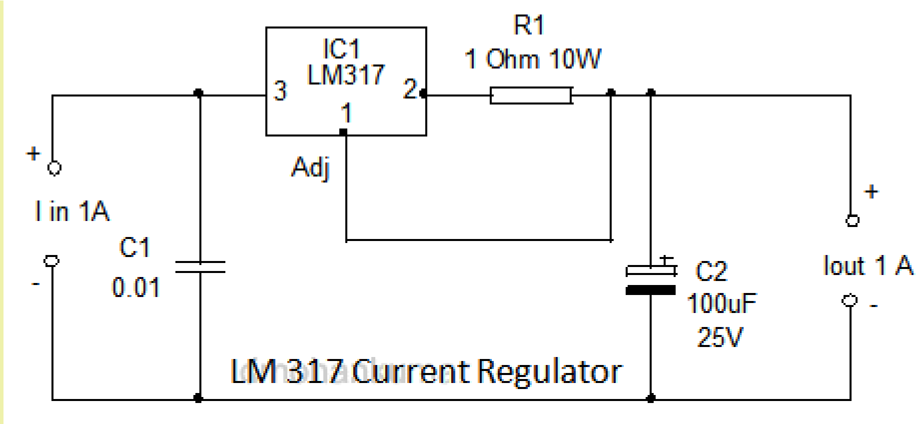
1. What is the purpose of the 47k resistor ?? It can be removed. It has no function.
2. You will get about 7 to 10 seconds with a 35k and 220u electrolytic. An egg takes 3inutes to cook !!!!
3. It is a VERY BAD DESIGN to "short-circuit" an output device to turn it off. This means the LOAD CURRENT is begin wasted via the transistor when the load is not being driven.
The output transistor is not needed. The buzzer and LED-2 can be connected between pin 3 and the positive rail. This will save 3 components and produce a better circuit.

PUSH PULL



There are no current limiting resistors. The LEDs will be destroyed if the pot is turned fully clockwise. Current-limiting resistors should always be included.

Look at this twaddle from Professor D.Mohankumar:



Current regulator
LM317 can be used to make a Current Regulator with constant output current. Figure shows a 1 Ampere current regulator circuit. Here the output voltage is fed back to the adjust pin. That is the low side resistor of the divider is with the load itself. The output current is that resulting from dropping the reference voltage across the resistor.

Apart from the poor English, the electronics expression is appalling. I don't understand what he is talking about.
The whole idea of a constant current circuit is to have an input voltage higher than the output voltage and the input has the capability of delivering a HIGHER current than will be provided at the output.
In the circuit above, the input current is 1amp,so why have a current-limiting circuit????
The current-limiting resistor is 1 ohm. If it passes 1amp, the wattage lost in the resistor will be 1 watt. Why specify 10watt ???
In fact he is entirely wrong in the following:
The value of the output current can be fixed using the formula
Iout = Vref / R1 (this statement is correct)
Suppose we are selecting 10 ohm resistor as R1, then the output current will be
1.25 / 1 = 1.25 Amps.
A 1ohm resistor will produce an output current limited to 1.25 amp. (not 10 ohm)

Practical Electronics for Inventors - hundreds of mistakes!

The discussion on EEV blog:
http://www.eevblog.com/forum/beginners/practical-electronics-for-inventors-3rd/105/
on the text book: **Practical Electronics for Inventors**
contains corrections on nearly every page of the book and the correction .pdf is almost 150MB in size:

https://onedrive.live.com/redir?resid=967A90CA47FD025B!172&authkey=!ACEbpvA4f9gUlxc&ithint=file%2c.pdf

It surprises me that many of the contributors to the corrections are still in "awe" of the qualities of this text book.
As one contributor said: It should be JUNKED.
The contributors stated they have had NO SUCCESS in contacting the author with the corrections.
This does not surprise me.
I have had exactly the same reaction.
That's why I say: you should be able to find almost any text book on the web as a free download and don't waste any money on any of them.
Read any text book with a lot of suspicion and double check anything you read by going to other text books and web sites for a clarification or comparison of confirmation.
I would be EXTREMELY annoyed if I found out statement was incorrect, especially if I paid for the book.

This website is one of the best on the internet:
http://www.eevblog.com/
and the discussion FORUM can be found here:
http://www.eevblog.com/forum/
The forum is very large and you will find hundreds of valuable contributions.

I have often mentioned the ineptitude of "Professors" and here's the latest:

I'm interested in your new TE555-1 IC and would like to know how it works before purchase for my class projects. Would you please send me the data sheet of this chip and the price break?
Thank you,

Regards,

Heidi Jiao, Ph. D
Professor of Electrical Engineering
Padnos College of Engineering and Computing
Grand Valley State University
616-331-6844

He goes on to say:

You advertised it as a 555 timer

I never advertised it as a 555 timer.

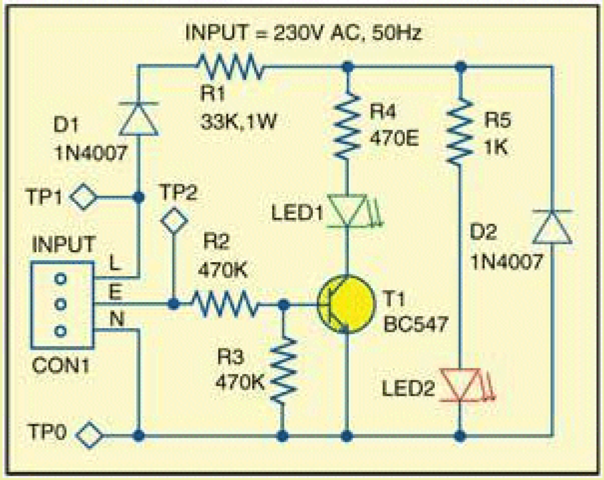
He could see from the circuit that none of the pins correspond to the 555 timer and the circuit performs completely differently to any 555 circuit. The number on the chip is **TE555-1.**
It is not shown as LM 555 or NE 555.
It's "Professors" like this that should not be teaching electronics.
They have absolutely no practical understanding of electronics and it's no wonder the students finish a course with no real understanding AT ALL.
He is **Professor of Electrical Engineering**. He should stick to electrical wiring.

Another "Professor" produced a video of a single transistor amplifier driving a speaker.
He failed to clearly mention how the current into the base was amplified by the transistor to drive the speaker.
I commented about this omission and was banned from making any more comments.
Not only do these "Professors" fail to describe the most important part of the exercise, but block anyone highlighting their ineptitude.
Another "Professor" said the base-emitter voltage can be as high as 3v for an NPN transistor !!!!
I pointed this out, as well as numerous other faults on his website and he immediately closed down the site.
Fortunately, no more Indian students could get hold of the RUBBISH he was presenting on his site.
This is just a few of the nonsensical comments made by teachers who have never actually tested any of the circuits they put on the web or consider they may have made a mistake.
They become quite indignant when someone pulls them up and takes them to task about the validity of the material they have produced.

EARTH DETECTOR

Here is another faulty circuit from **Professor D.Mohankumar.**
It is supposed to let you know if the earth is connected or not connected at the wall socket.
He states:
The circuit uses the potential difference across the Neutral and Earth lines. Neutral-to-earth voltage as measured at the load for a single-phase circuit is a function of the load current and the impedance of the neutral wire. Various standards limit this voltage drop in a branch circuit to 3% (5% per cent total for feeder and branch circuit) for a reasonable efficiency of operation. Based on this, the neutral-to-earth voltage limit for a single-phase 120V AC circuit is 3.6V AC and for a single-phase 230V AC circuit 6.6V AC.

This part of his reasoning is correct. The voltage-drop in house wiring should be as small as possible and in modern wiring the drop will be less than 1 volt in the active line and 1 volt in the neutral line.
However this voltage-drop only occurs when the load is say 2,000 watts and you cannot detect this drop without a load.
The following circuit will NOT detect any problem with the earth wire, even if you connect a load to the system as any voltage-drop in the neutral wire will make the neutral wire slightly HIGHER in voltage than the earth wire.
This circuit will NEVER work and is a dangerous circuit as it produces a FALSE READING.
This circuit was presented in **ELECTRONICS FOR YOU** Magazine, without ever being tested.



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SPOT THE MISTAKES!

Page 24

The amount of material being added to the internet is phenomenal.
It is claimed 300 hours of videos is uploaded to YouTube every minute.
But the biggest change has been the decline in magazine sales.
This doesn't seem apparent as most magazines still strive to present a successful approach by keeping up appearances and maintaining a reasonable thickness to their monthly edition.
But the underlying facts are different. Sales are declining with each issue and it comes to a point where the readership is so low that advertisers are simply "supporting a sinking ship."
Nearly every magazine is now available on the web as a free download and after thumbing through the pages, it can be deleted and "returned to the clouds."
I have reduced my huge pile of magazines by saving the articles and discarding the rest.
A 3 metre pile is now less than 10cm.
You have to get savvy with everything you do and realise a magazine is a vehicle for advertisements that you don't need, with a few pages of articles that can be retained, providing you can access them at a later time.
This was done by Kendall Webster Sessions in his books of 1,000 circuits, but many of these circuits used old-style components and you have to update transistors and IC's with presently available components to get the circuits to work.
It would be a very valuable exercise to collect all the projects from defunct magazines and present them in indexed form so readers can see what has been presented.
The closest I have done is gather together hundreds of websites where thousands of circuits have been presented: P1 P2 Other authors
The microcontroller has made many of these circuits "redundant" by decreasing the complexity of 5 or 6 chips to a single 8 pin micro.
And the release of new chips has made the old-style chips slow, current-hungry and difficult to obtain.

I thought I was the only one noticing the number of mistakes in text books.
But there are a number of groups on the web with a list of mistakes in many of these "bibles."
Everything would be fine if the author and/or publisher had the gumption to admit to the mistakes and provide a set of errata.
But, not only does the author fail to respond, but the publishing house also fails to reply.
Some of these texts have numerous mistakes on each page and I would be furious if I trusted a piece of information that was incorrect.
I know it's nice to have a physical book in your hands, but most of these text books provide very little information on each particular topic and you are best to Google what you want and get 100 resources.

These pages allow me to describe all sorts of things that don't fit into normal articles on circuit designing.
They allow such topics as "if it doesn't work" and "why it doesn't work."
These are things that are NEVER mentioned in any text book and are actually the MOST IMPORTANT part of learning.
This concept came about after fixing more than 24,000 TV sets and associated electronic gear and finding circuits that failed after a long period of time.
Things that you would never expect to go faulty, such as a 27p ceramic in the tuner of a TV or a vertical transformer causing the vertical control to run out or range and cause the picture to roll.
Or the 27k resistor missing in an HMV power supply that allowed the supply to start up when the main transistor lost some of its gain.
These sorts of things were never taught in University or trade-school and made servicing a challenging occupation.
Unless you can "see" a circuit working, you have no idea where to look or visualise how a faulty component will affect the operation.
That's what Talking Electronics is all about.
It aims to show the concept of seeing a circuit working and thereby designing it correctly in the first place or allowing the technician to fix it.
As you can see from these pages, the designers of many circuits do not have the ability to do this and when they say it is not possible to have the ability to "see" a circuit working, you can see why they are making these mistakes.
It's only by reading lots of articles and studying many different circuits that you will improve your capability.

There are actually two different requirements for a text-book.
No-one has actually thought of this before.
Students source information for two different reasons.

In most cases a student wants to cover a topic completely . . . starting from the beginning and covering EVERYTHING.
But another requirement is for an answer to a specific question.
That's where Google comes in.
You simply type in your question and 10,000 answers appear in 0.1 seconds.
That's the brilliance of the internet.
And that's why text books are being relegated to the book-shelf.
I have donated my $4,000 set of Encyclopedia Britannica to the op-shop.
They were just taking up shelf space.
The same with many electronics text books.
You can find the answer quicker on the web.
To do this, just type: talking electronics and then your question, into Google and it will immediately provide the results. Google has cached every single paragraph on Talking Electronics website and it can provide an answer faster than any indexing by me.
It's through these searches that the website gets 6,000 visitors each day.
And it's through all sorts of odd questions from visitors that new topics can be written.
That's how the website expanded into its 180MB present form.

Some of the most important concepts for understanding electronics is contained in these pages.
You can learn more from a faulty circuit than a hundred pages of text.
The author has serviced hundreds of TV's and electronic appliances that failed after a week, month or year due to a circuit being on the "brink of failure" due to components or values that were just NOT GOOD ENOUGH.
Some of these faults were responsible for the collapse of some companies and certainly of some product-lines.
You can learn so-much from other peoples mistakes and this can turn you into a brilliant engineer.
That's what these pages are all about.

Here's one of the stupidest projects imaginable.
It is a 10v reference to check the accuracy of a Digital Multimeter.

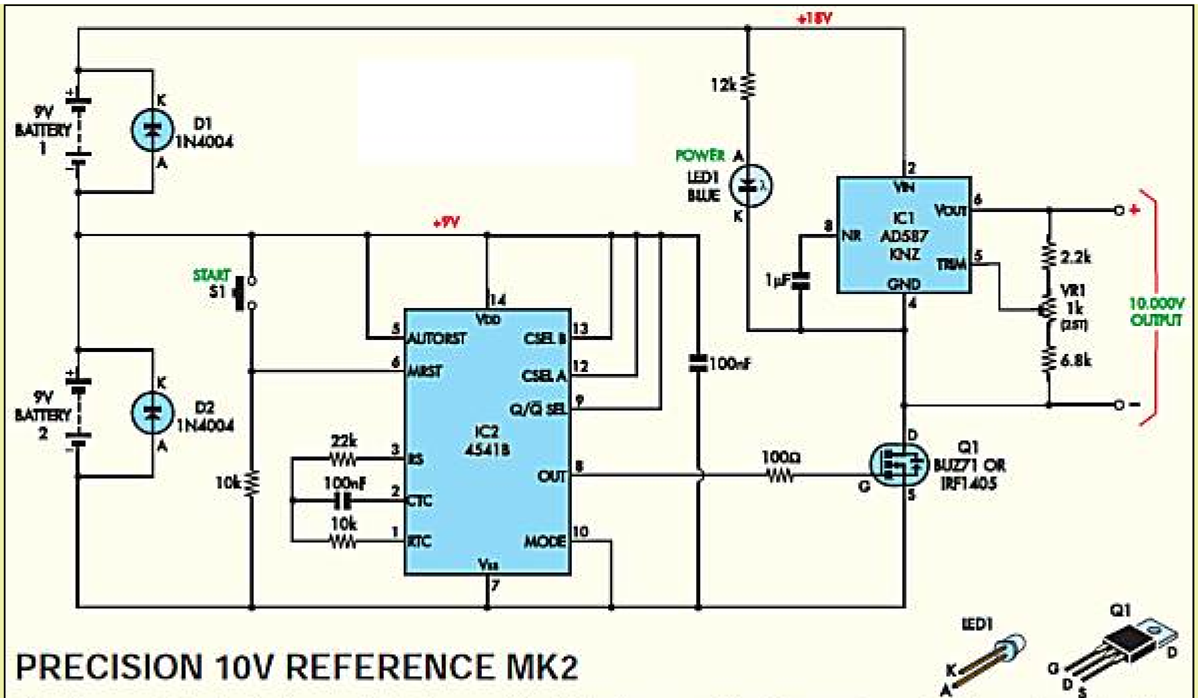
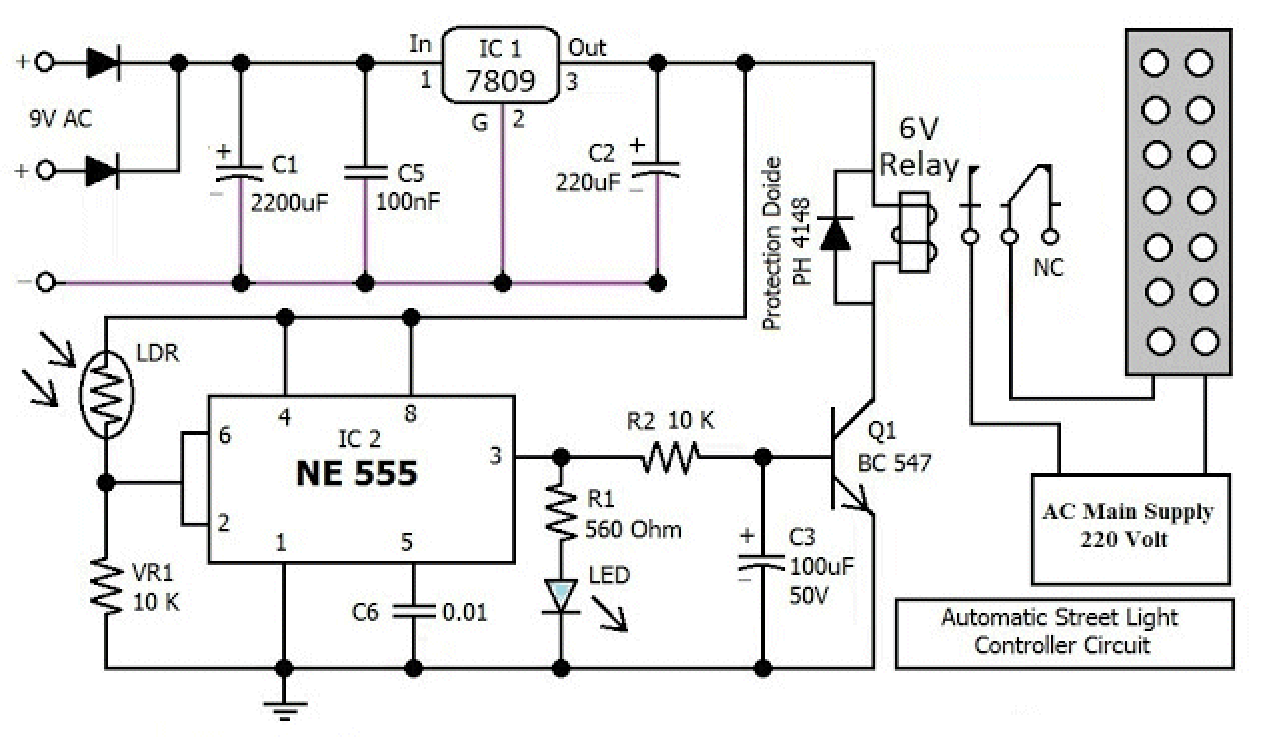


Fig.2: the complete circuit diagram. IC1 is the precision 10V reference, while IC2 operates as a 90s timeout counter. When S1 is pressed, IC2 turns MOSFET Q1 on for 90s and connects IC1 and LED1 across the 18V supply.

Firstly, most digital meters do not have any adjustment and it is pointless building an accurate voltage reference. However I have found the reading from different meters to have a wide variation and I don't know if the fault develops over a period of time or due to the inherent inaccuracy of the meter when purchased.
Instead of spending money on a complex project, you can simply use a few mercury cells or silver oxide cells to determine the accuracy of a reading.
Fresh mercury cells have a terminal voltage very close to 1.356v at 20°C and silver oxide cells have a voltage very close to 1.55v
You can use 2 or more of these in series to get a reading of say about 5v and check your meter accurately for a few dollars. You can then use the cells in a piece of equipment and not waste them.
The other problem with the circuit is this: the 4541 is connected to the battery AT ALL TIMES and the battery goes flat after a few months !

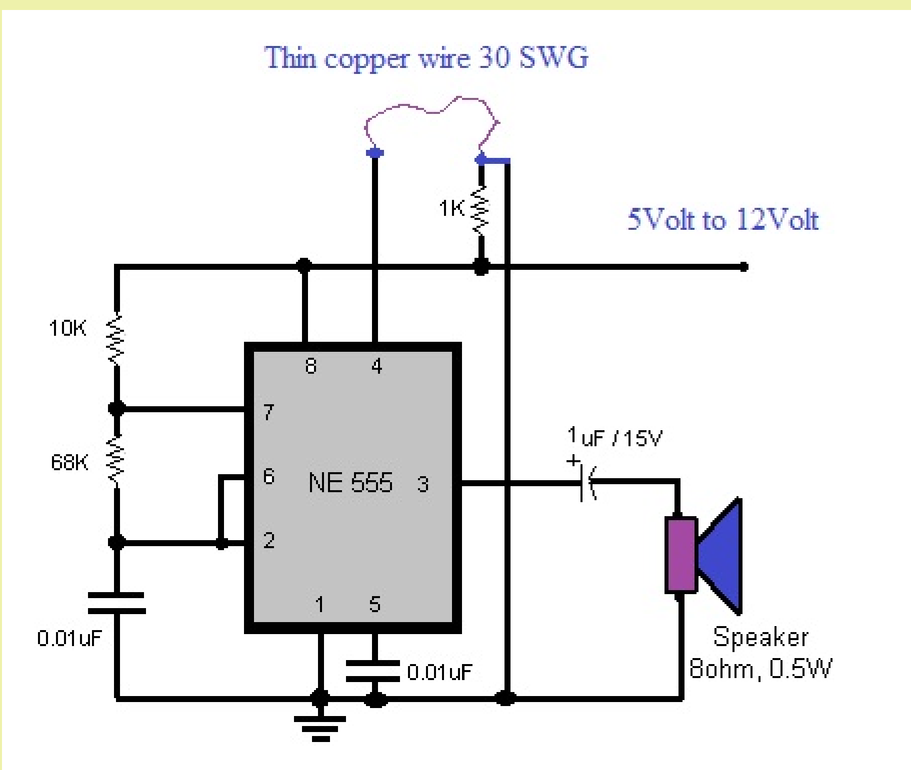
STREET LIGHT

http://hobbyelectron.blogspot.com.au/2012/03/automatic-street-light-controller.html



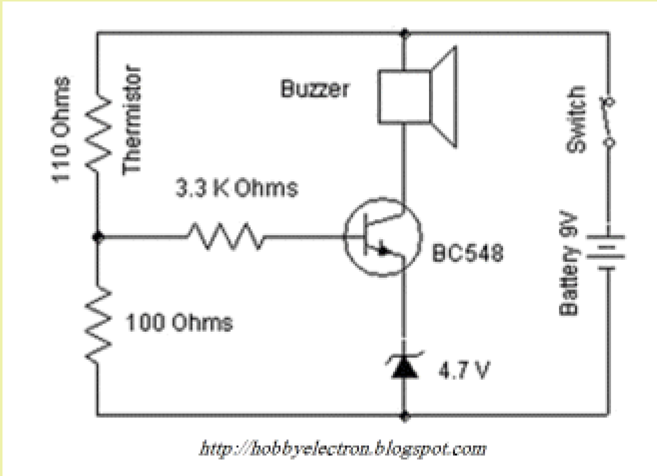
What are the 9v AC connections ????? How is the AC connected ???
Why use a 2200u for 100mA circuit ????
Why have a transistor buffer when the 555 will deliver 100mA !!!!
Why is C3 50v when the voltage will be 0.7v MAXIMUM !!!!
Why use a 7809 regulator when a 9v zener diode can be used.
VR1 is not a variable resistor. VR is used for a VARIABLE RESISTOR.

STREET LIGHT



The 555 IC takes 10mA ALL THE TIME and the battery will be flat in a few weeks !!! The 1k is constantly across the supply. The 555 will not "turn-ON" when pin 4 is floating.

Here's another circuit that may not / does not work:

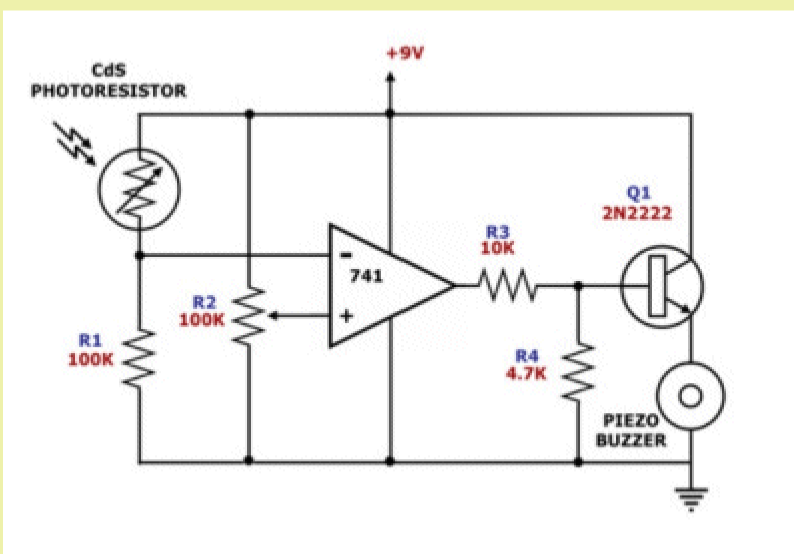


Here is the poor description of the circuit as presented in Hobby-electron:
The thermistor resistance value is 110 ohms. Suppose the resistance becomes 90 ohms after heating the thermistor. Then the voltage across one resistor of the voltage divider circuit equals the ratio of that resistor's value and the sum of resistances of the voltage across the series combination. This is the concept of a voltage divider. The final output voltage of the voltage divider circuit is now applied to the NPN transistor (BC548) through the base resistor (3.3k ohms). The emitter has a 4v7 zener diode. Emitter voltage is maintained at 4.7volts via the zener diode. This voltage is used to compare voltage. Transistor conducts when base voltage is greater than the emitter voltage. Transistor conducts if it gets more than 4.7volt of base voltage. Then the circuit is completed through buzzer and it gives sound.

The above statement is correct, but the voltage on the base has to be 4.7v plus 0.6v = 5.3v.

To get 5.3v on the join of the two resistors, means the thermistor has to drop to 70R.
At 5.3v, the transistor just turned ON and the thermistor will have to go to a lower resistance to allow the transistor to deliver CURRENT to the buzzer. It will be difficult for the circuit to work successfully.

Here's another circuit that may not / does not work:



The voltage available for the piezo buzzer is less than 9v.
The output of the op-amp will be a maximum of 8.5v.
The voltage divider will drop this to 4v.

The emitter will be 3.4v The piezo buzzer will not be very loud !! But some buzzers produce an output when the supply is 5v, so get a 5v buzzer and remove R4.

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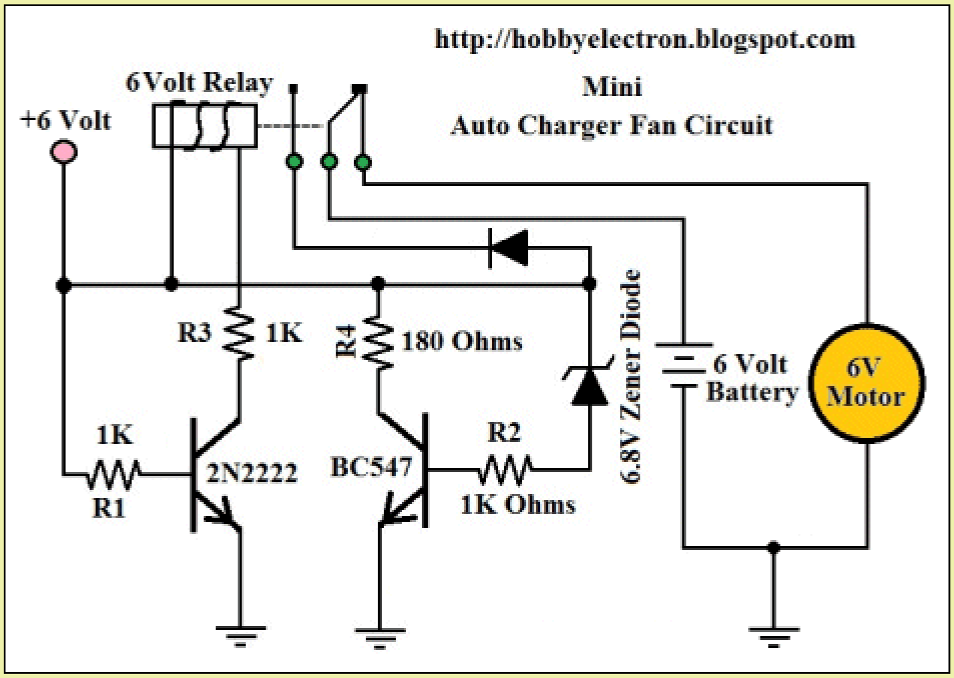
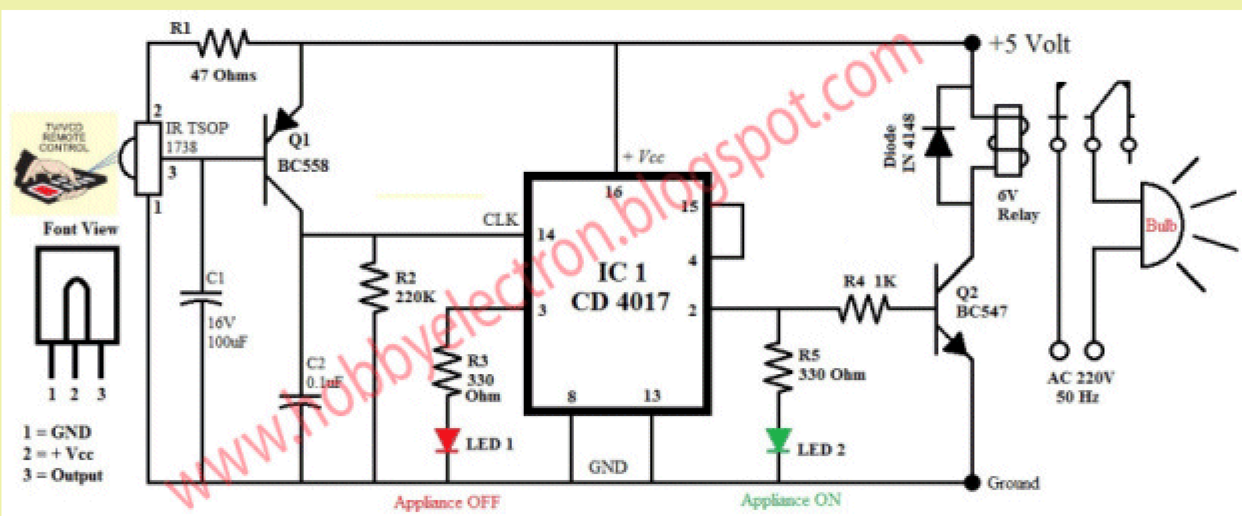
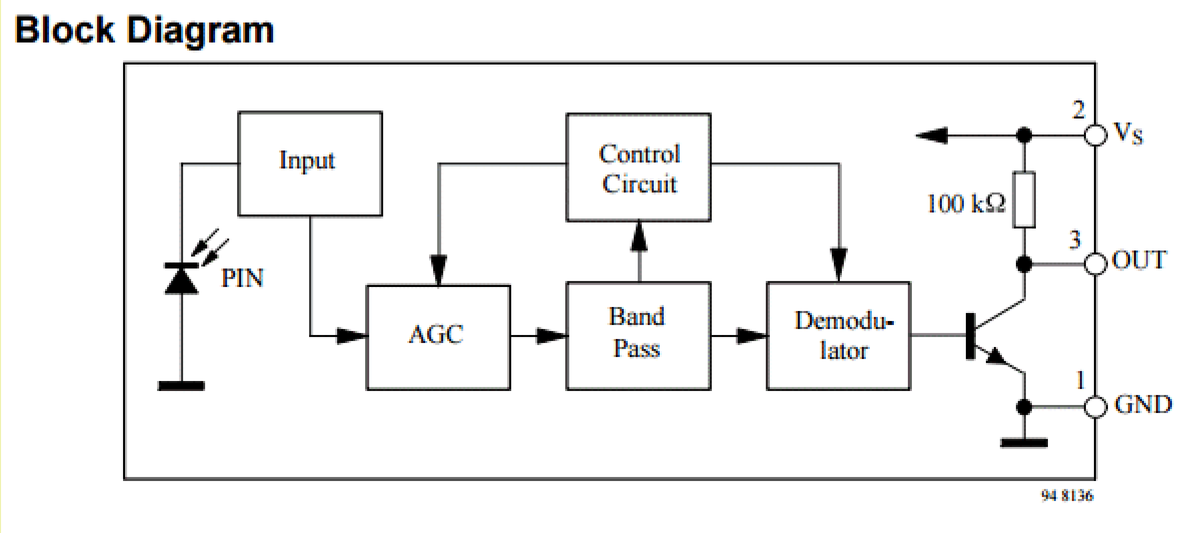
http://hobbyelectron.blogspot.com.au/2011/08/mini-auto-charger-fan-circuit.html

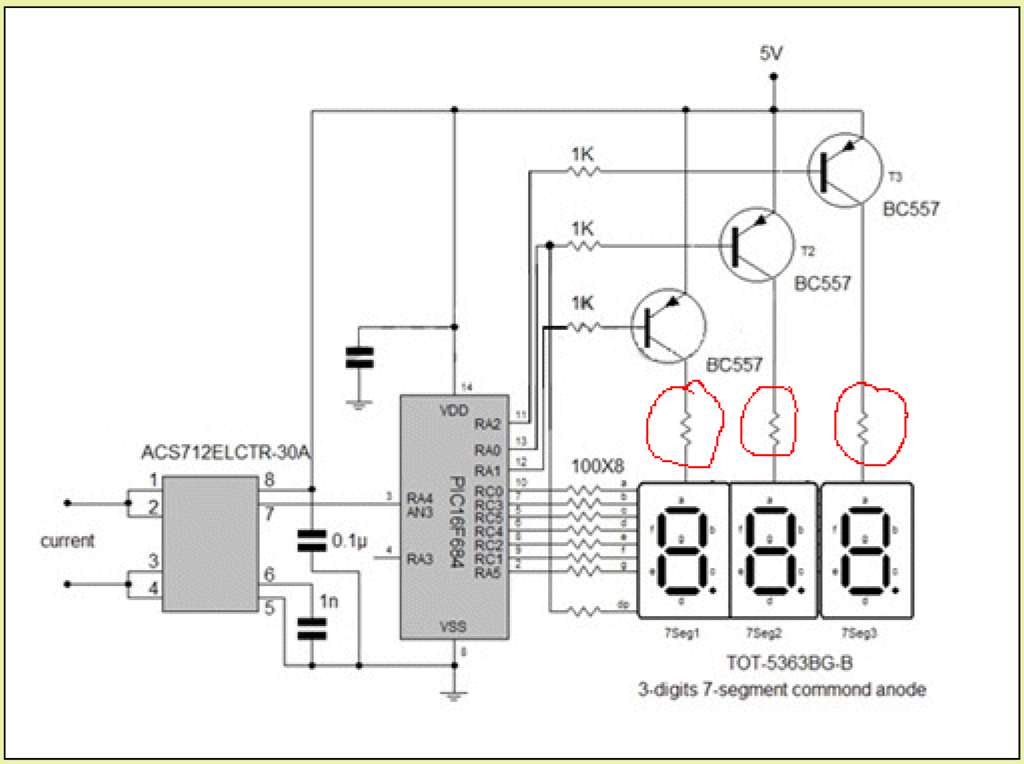


The BC547 is supposed to control the charging of the battery.
The 6v input voltage will NEVER charge a 6v battery.
The BC547 transistor and 180 ohm resistor will simply add a small load to the 6v (should be about 9v) supply.
It will have NO effect on adjusting the current to the battery.
This is another circuit that DOES NOT WORK. It has never been built or tested.

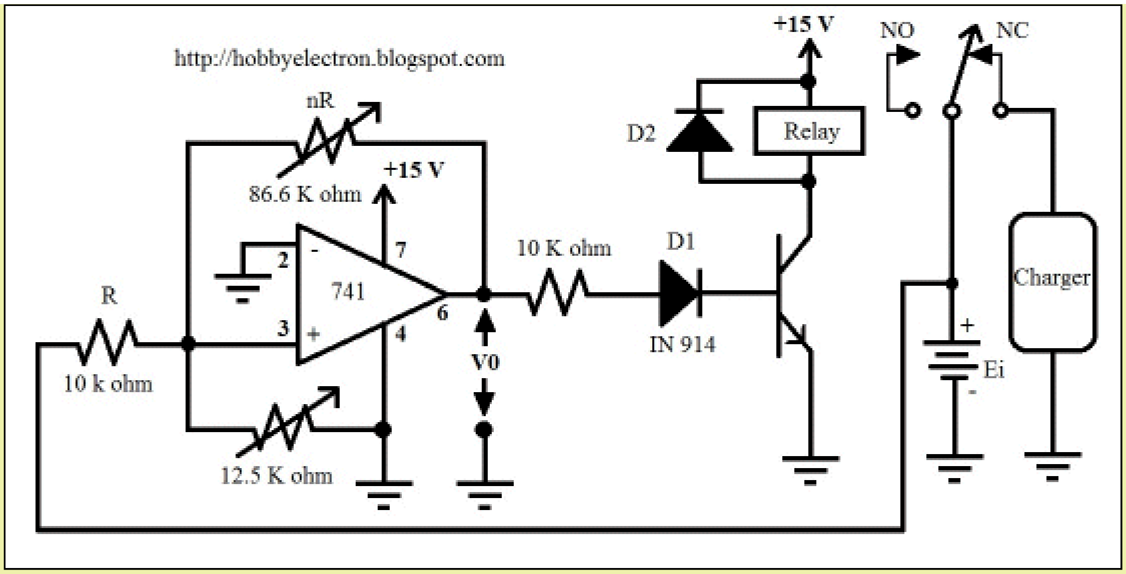




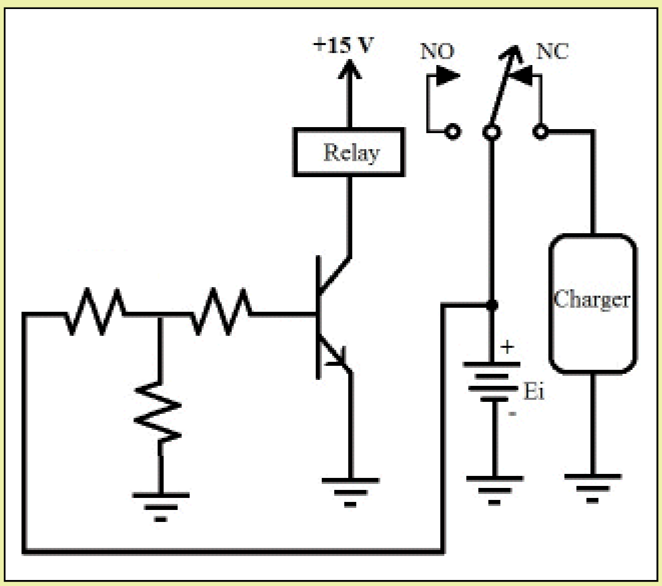
When the TSOP1738 turns ON, the transistor inside the detector and the BC558 will allow a very high current to flow because there is no current-limiting resistor.
Another circuit that has never been tested.



You don't need the digit resistors as well as the resistors for the segments. In fact the digit resistors will make the segments very dull when all the segments are illuminated.   Another circuit that has not been tested.
The project does not provide information for the program for the PIC chip, so it cannot be constructed.



Let's look at this circuit.
The op-amp is not needed.
The two diodes are not needed.
The circuit can be simplified to a voltage-divider that detects the upper voltage and activates the relay.
This is how the circuit can be designed:



Always check each component to see if it is necessary and look on the web to see if the same function has been done is a simpler way.

WIND CIRCUIT

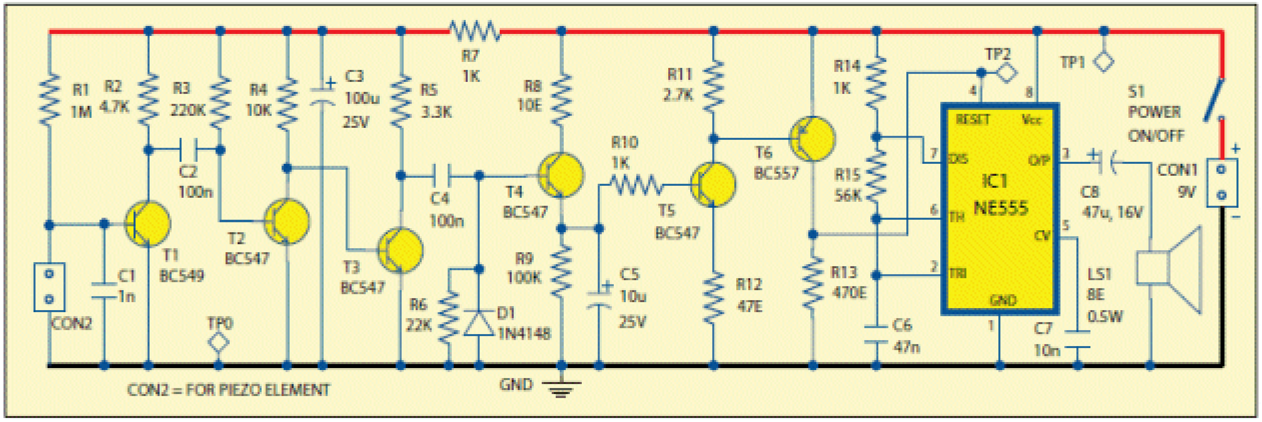


Fig. 1: Circuit diagram of the air motion detector

Let's look at this **WIND CIRCUIT**.
It produces a tone when a strong wind blows across a piezo element.
It has been designed by some who knows very little about electronics, but let's look at the design-faults.
Firstly, the gain of a transistor is about 70 - 100 so you only need 3 transistors to convert the 10mV to about 2v.
There is no CURRENT REQUIREMENT because pin 4 of the 555 is a high impedance pin.
You only need to raise pin 4 two volts for the chip to turn ON - it does not have to rise to 9v. Pin 4 has to drop to 0.5v to turn the chip OFF. But when it is turned OFF, the chip still takes 10mA and that's one of the reasons why a 555 should not be used.
The piezo element is equivalent to 22n, so C1 (1n) is NOT needed.
The piezo element is a very high impedance device and the 1M base-bias resistor is effectively acting as a LOAD. This is because the positive and negative rails are technically connected together as far a signal is concerned, due to the battery having a low impedance and the 100u across the rails.
If the 1M is changed to 2M2, the circuit becomes more sensitive.
The next important point to understand is the fact that the transistor effectively multiplies the collector resistor by 100 (the gain of the transistor) and if this resistor is increased to 47k, the stage will be more sensitive.
This means we can eliminate the second transistor. (actually the third transistor)
The fourth transistor is not needed as we can charge the 10u from the second transistor.
This electrolytic can be taken directly to pin 4 as pin 4 is a high impedance pin and the chip will turn ON.
Charging the 10u is not a high impedance operation, but we are using the TIME DELAY in charging it, to produce a delay before the 555 turns ON.
The 6 transistor circuit can be reduced to 2 or 3 transistors.
Two more components that show the designer has no understanding of electronics:
The 10R resistor R8 is not needed.
The 470R R13 is a low value across a high impedance pin. This can be increased to 1M.
This circuit shows a complete lack of understanding of IMPEDANCE VALUES.
Impedance values are effectively resistance values and both the detecting device and pin 4 are high impedance.
The surrounding circuit should also be high impedance. That's the skill of being a design-engineer.
Read the article: **THE TRANSISTOR AMPLIFIER**.

MAINS INDICATOR

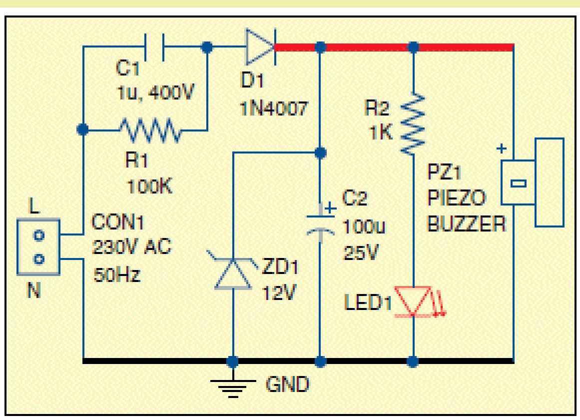


Fig. 1: Circuit diagram of the mains power indicator

Neutral must NEVER be connected to ground.
The actual project does not connected the neutral lead to ground (earth) and the circuit diagram is INCORRECT.
If you connect the neutral lead to the earth lead on a project, the fuse will blow if the active and neutral are swapped.
They may get swapped if you use an extension lead that has been wired incorrectly.
The circuit will deliver about 35mA. The LED will take 10mA.

MUSEUM ALARM

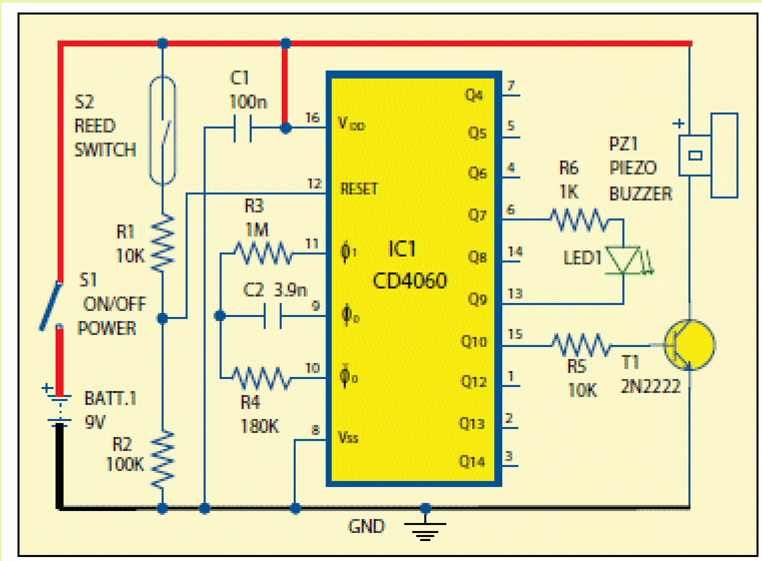
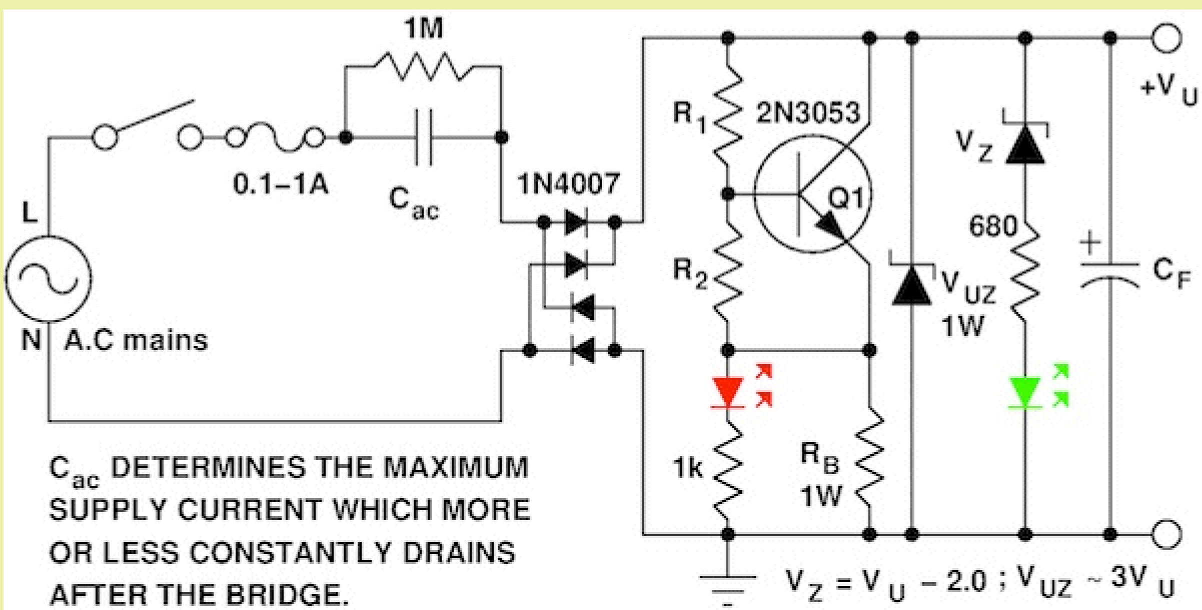


Fig. 2: Circuit of the museum watchdog

Another badly designed circuit from T.K. Hareendran

Why have a circuit taking power all the time. ????
You can get reed switches that are change-over or have two contacts that are separate when a magnet is present and make contact when the magnet is removed. This way the circuit takes NO POWER.
What is the purpose of R1. ?? The reset line is high impedance and does not need a 10k resistor.
Using Q7 and Q9 to blink the LED will put a reverse voltage on the LED. Use one output and 0v.
The battery will be flat in a few months.

CAPACITOR SUPPLY



Here is a capacitor-fed supply, dressed-up to look impressive, by using a few "uz" values, on an Electrical Design Network website, from Raju Baddi:

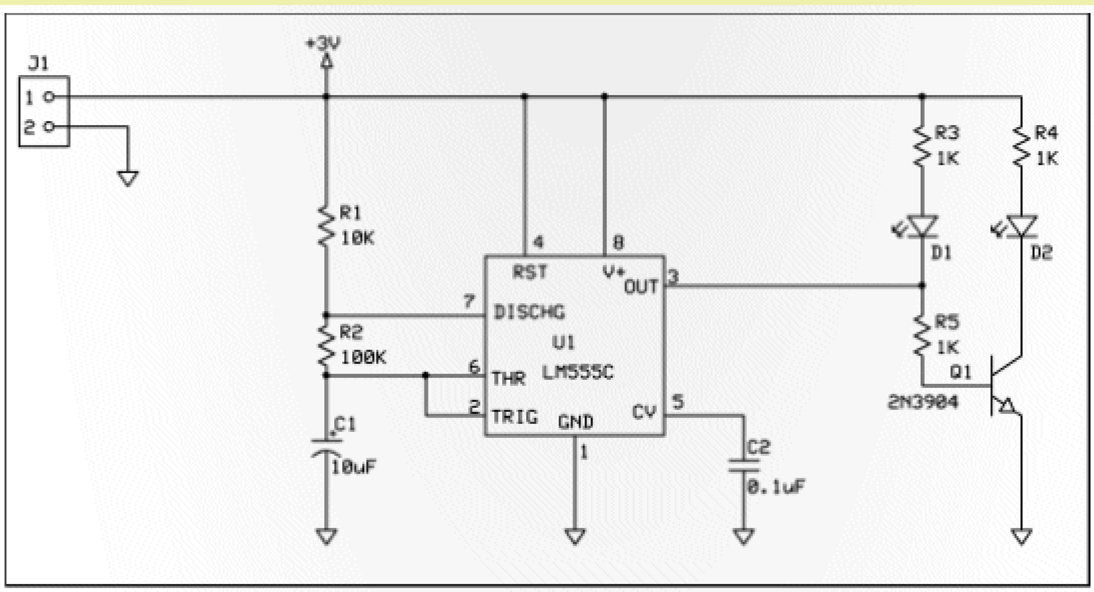
But is just another over-designed piece of RUBBISH and none of the 56 replies from the readers had any understanding of the dangers of this project.
The circuit is classified as a CONSTANT CURRENT CIRCUIT. What is the purpose of the transistor???? It does nothing AT ALL.
I can't blame Raju Baddi for this rubbish circuit as none of the readers (except 3) realised the dangers of this type of supply.

There are so many mistakes with this circuit, that is should never be built.
Here are 5 faults:
A 100R to 220R safety resistor should be included in the AC line.
The earth symbol should be removed.
The circuit is overly complex.
The circuit will deliver 7mA for each 100n of the X2 rated AC capacitor for a 240v mains.
This is all that is required and not all the rigmarole of a formula.
The circuit will not drive a 555 using a 0.068u as the 555 requires 10mA! There is nothing left to drive the LED
Transformerless circuits like this are very dangerous and BANNED in Australia.
There is no point in using a 2N3053 when Rb is only 1 watt!
There is no point in using zener Vz when a current limiting resistor is also employed.
The Engwish used in the text is undecipherable. What does: "Cac constantly drains after the bridge" mean????
Just a bad circuit with NO technical expertise behind it.

This is my reply to the project on the Network website:

This is an extremely dangerous circuit.
All the comments such as: "I'm a little surprised to see so many comments that call this type of reactive supply unsafe " are quite ABSURD.
As soon as the wires to the mains are reversed, the device being charged is at a potential of 180v or 345v.
There is no such thing as 120v or 240v (This is another fact that all readers have overlooked). The power supply may be insulated, but no mobile phone or toy is insulated to this degree.

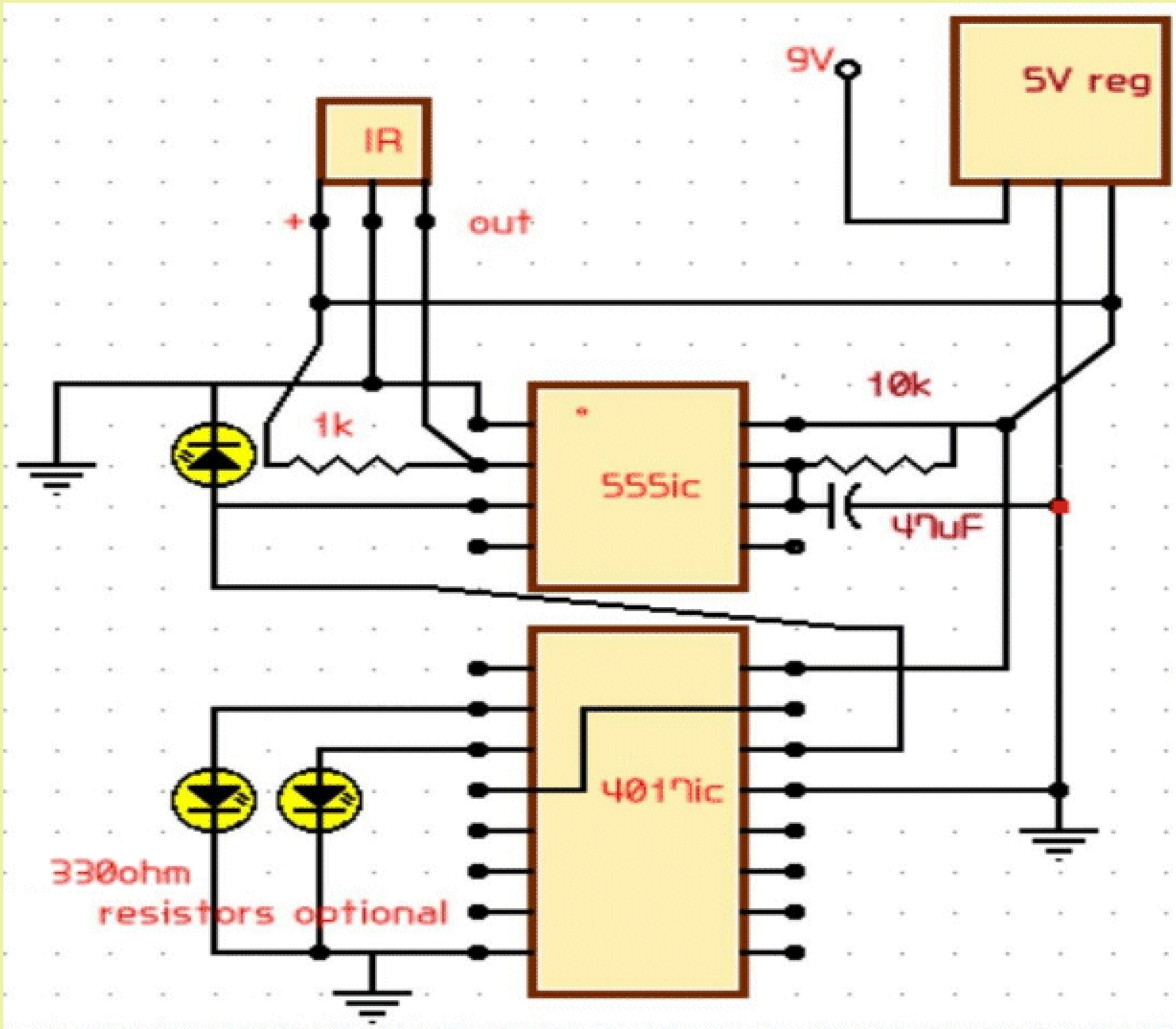
FLASHER



Flasher schematic

What is the purpose of the transistor ??
Remove the transistor and connect the LED between the lower lead of R5 and the 0v rail.

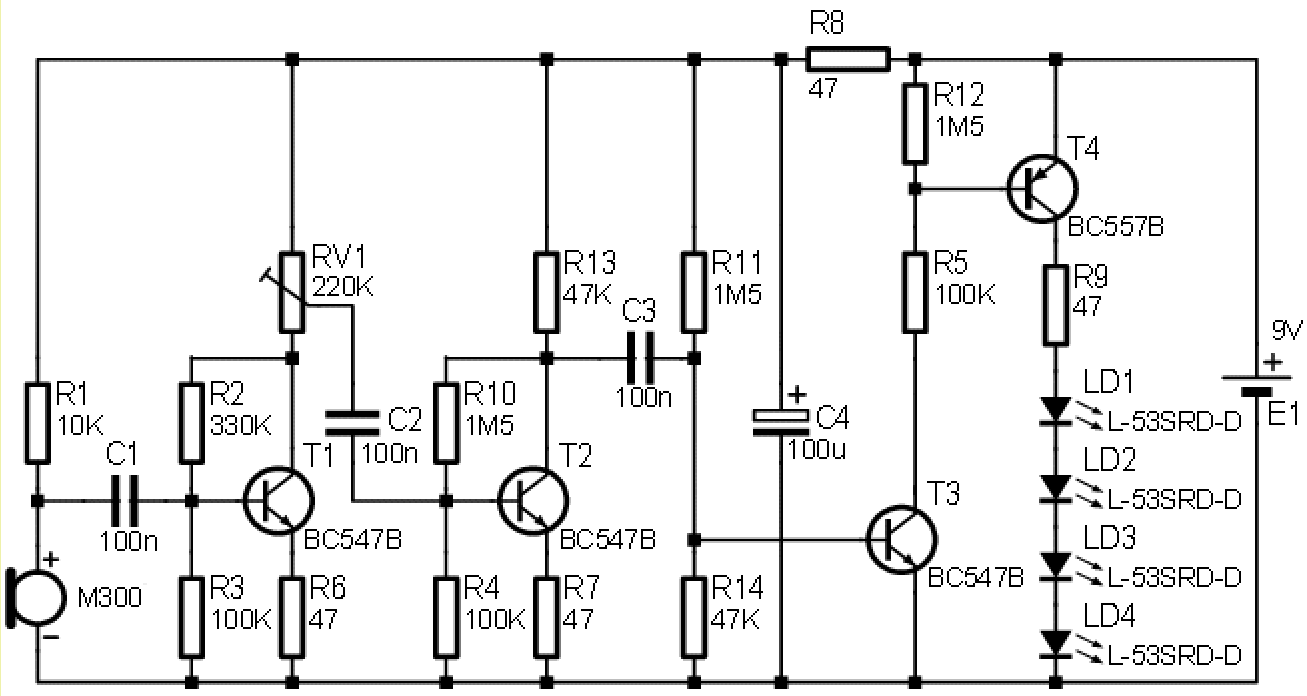
Here's a project for beginners from Jameco Electronics:

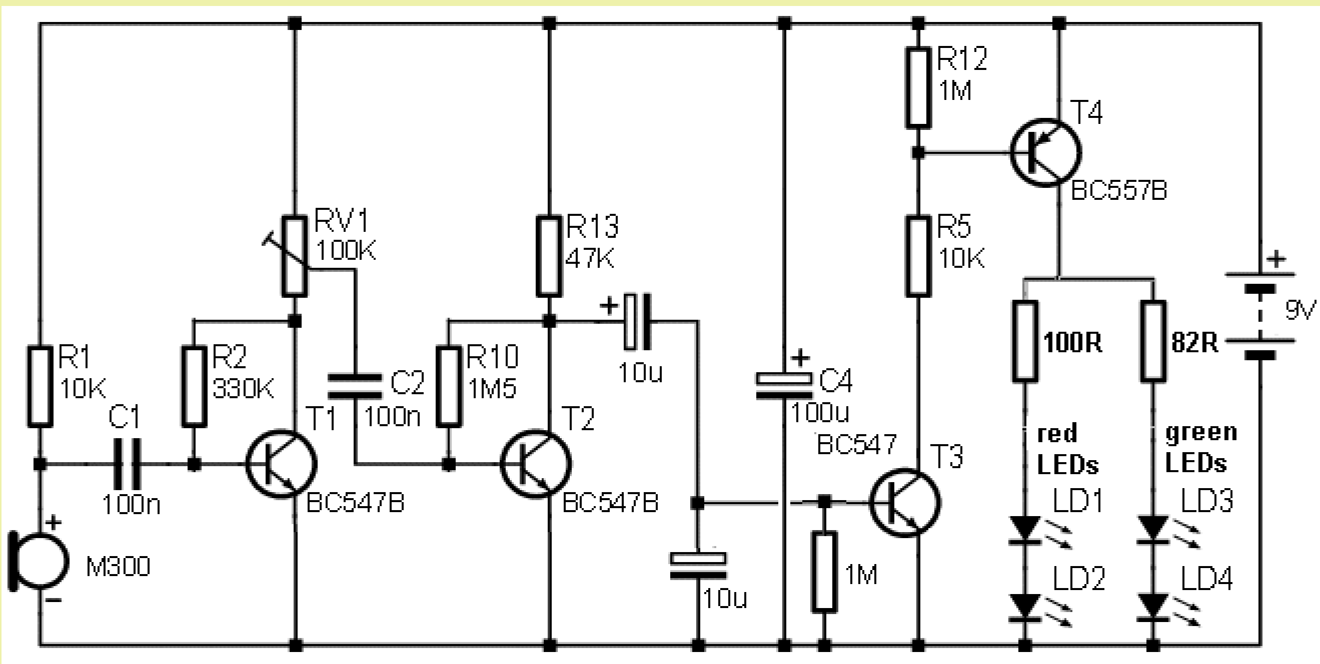


It is filled with mistakes. I could not build it and I've had 50 year experience in electronics.
What is a 3-pin "IR" ???? The text says it is an IR transistor.
Pin 4 of the 555 is not connected.
No 330R current limiting resistors on the LEDs.
The diagram is NOT a circuit diagram. It is very difficult to work out what is happening if you don't draw a CIRCUIT DIAGRAM.
The 4017 will never "clock" with a LED on the clock-line.
Just another JUNK circuit - not to be constructed.

AUDIO LEDs

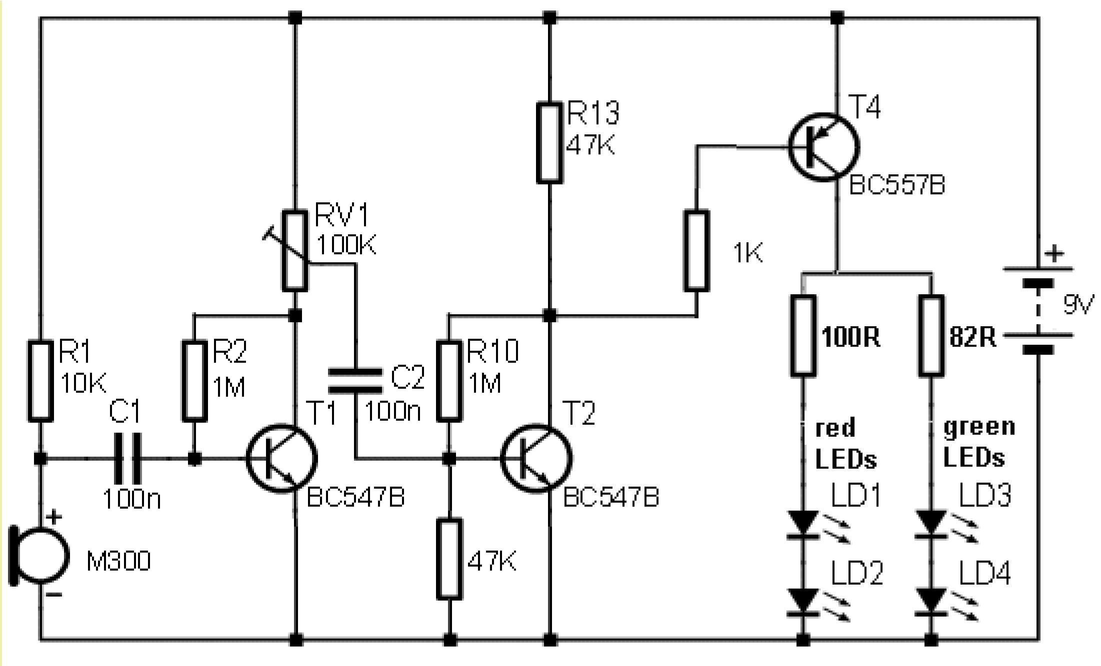
Here's a poorly designed circuit from Velleman. It is over-designed. You don't need to bias the transistors into their "linear range" for a simple amplification requirement. This is not an AUDIO AMPLIFIER. It is just a SIGNAL AMPLIFIER.





The second diagram allows the battery voltage to drop to 5v before the circuit fails to work.
It also has a slight delay to create after-fade for the LEDs.
All the unnecessary components have been removed.
This project show the lack of circuit-understanding on the part of Velleman engineers.
The whole secret of designing a circuit is to use the least number of components and avoid as many mistakes as possible.
The original circuit will stop working at 7v and the third 100n should be increased to 1u to 10u as the current increases through the circuit.
The 100k on the base of the base of the 4th transistor is far too high. The 47R as the current limit resistor shows a complete lack of understanding "head-room" for strings of LEDs.

The circuit can be reduced to 3 transistors and fewer components.
The original circuit did not take full advantage of the gain of each stage and the revised circuit is just as sensitive with 3 stages:



The final circuit uses just 3 transistors and fewer components

We have had to reduce the sensitivity of the second stage so the LEDs do not turn on due to the background noise.
The first stage in the circuit is really the microphone and 10k as the microphone contains a FET transistor and this is effectively an amplifying component.
The 10k resistor is far too low for a microphone in a normal audio amplifier as our electret microphones need 47k current limiting resistor for 9v. When using 10k, the output is far too loud and completely distorted because the 10k is allowing far too much current to flow through the microphone .
For this circuit we only need a signal and the quality of the signal is not important.
The next stage is a self biased transistor with a gain of about 70 to 100. It does not matter what type of transistor you put in this stage. The gain of most transistors is above 100 but the 1M between the base and collector is effectively a feedback resistor that reduces the gain.
The output is taken to another self-biased stage with the biasing on the base creating less than 0.6v so the transistor is NOT TURNED ON.
The actual voltage is about 400mV. This means the signal coming from the microphone and through the first amplifying transistor has to be about 300mV or more, to increase the voltage on the base to above 600mV to turn the transistor ON. The slightest noise produces this type of signal.
Once the second transistor is turned ON, it pulls the base of the third transistor low via the 1k resistor and this allows it to illuminate the LEDs.
The circuit consumes less than 0.5mA when "sitting around" - this is called the QUIESCENT STATE.

See our 30 LED Projects eBook for more circuits like this.

FAULTY BRIDGE

Look at the blurb T. K Hareendran says about himself and yet he cannot draw a bridge rectifier circuit. Almost all his circuits have faults. He knows practically NOTHING about electronics and you can see some of his other faults in previous pages. Here is his blurb:

T.K.HAREENDRAN I am an Internationally Certified/Technically Qualified Professional Freelance electronics circuit designer, technical writer, columnist, consultant, domain expert&trainer based in Kadakkal (Kollam-Kerala)India.My works have appeared in leading print&online media, in India and abroad, since 1988.I write on varied topics including Electronics, Computer, Technology, Business, Healthcare, Astrology and Life, etc. My articles have appeared/scheduled to be appeared in Electronics For You(I), Elektor Electronics(UK), Silicon Chip(AU), Nuts&Volts(UK), Everyday Practical Electronics(UK), Electronics Maker(I), Electronic Design(UK), Infokairali(I), Electronics Cable Chip(I), Television For You(I), Electronics Hobby Circuits(I), Malayala Manorama(I), Mathrubhumi(I), Deshabhimani(I), Balabhumi(I), Mangalam(I), Labour India (I), Kunkumam(I), Hasyakairali (I), Techvidya(I), Cartoon plus(I), Madhyamam (I) and several other publications. I have authored a number of best seller books, e-books,

electronics/computer repair manuals and interactive tutorial CD/DVDs. One of my best seller print in Malayalam is "Electronics"- Published by Infokairali(I). Follow me on http://twitter.com/tkhareendran

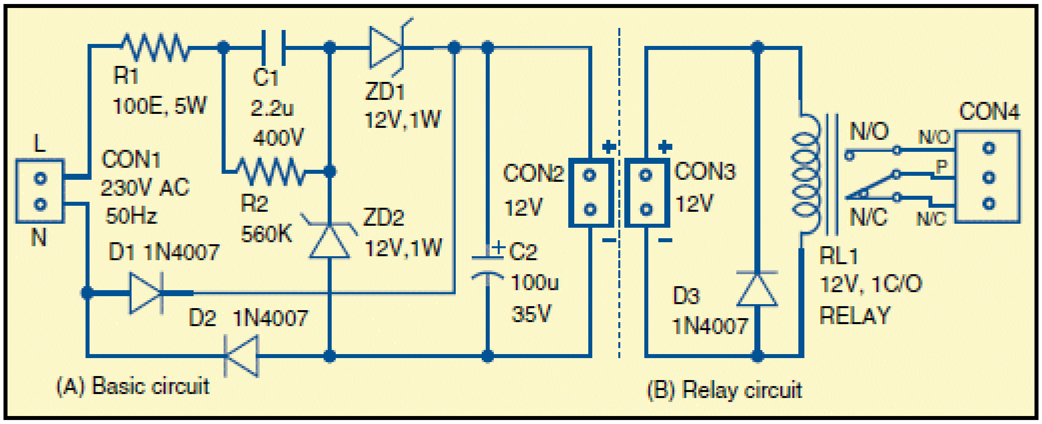
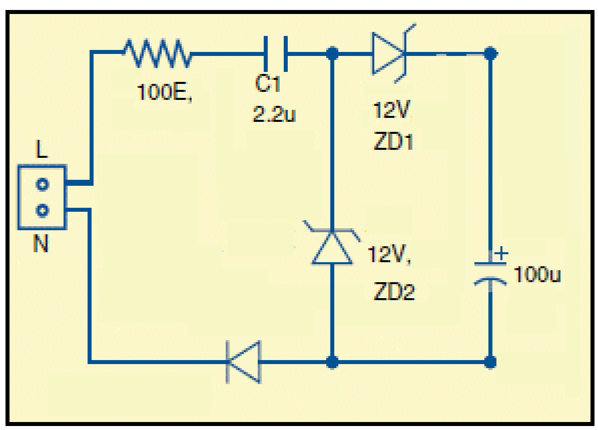


Fig. 2: Basic circuit with a relay

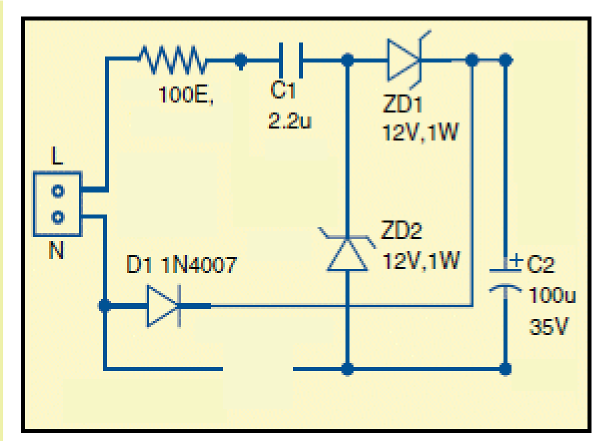
I have mentioned on many occasions, DON'T DRAW CIRCUITS IN A NON-CONVENTIONAL WAY.
The circuit above is just a MESS and no-one will be able to see the mistake because of the way it is drawn.

Here's an explanation why the circuit WILL NOT WORK.
Firstly we draw the circuit with the "L" wire producing a POSITIVE waveform:
I have removed all the unnecessary writing and components that are not involved.
At this point in time I do not know if the circuit will work, so let's go through the situation.
Basically the current runs around the outside with the resistor, capacitor, zener, electrolytic and lower diode.
The 100u would normally see 345v across it but ZD2 reduces the voltage to 12v. This means the maximum voltage produce by the circuit is 12v across ZD2. If we now have ZD1 removing 12v from the "supply" the electrolytic will see ZERO VOLTS !!!

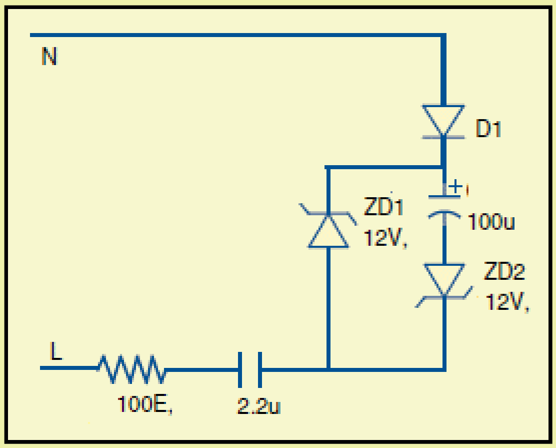


The 100u sees ZERO VOLTS !!

Now we go to the second half of the "charging cycle."
Here is the circuit:



Everything looks good until you analyse the circuit and re-draw it so you can see what is happening:



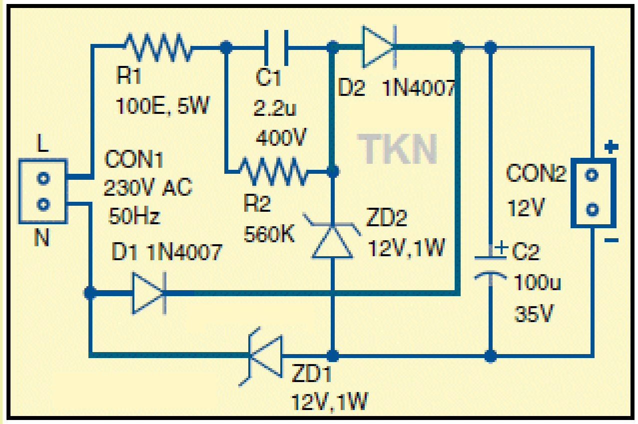
The Neutral is now producing a POSITIVE waveform and this passes through diode D1 to the 100u and via ZD2 to the 2u2 and 100R current limiting resistor.
But ZD1 limits the voltage across the 100u to 12v and if ZD2 removes 12v from this "supply" there is no voltage available to charge the 100u !!
It's a simple as that.
But to see these faults, you MUST draw the circuit in the CONVENTIONAL WAY so you can "SEE" what is happening. I had no idea the circuit would not work until I re-drew it.
I am not "Mr Marvel Man." I cannot see through buildings or see how a circuit works unless it is drawn correctly.
But just seeing a project by T. K Hareendran makes me look closely and analyse things thoroughly. His junk circuits can be seen everywhere.

Here is his reply:

The prototype is working well here since the last 90 days. However, I will send you an explanation after reading your fantasy posted in spot the mistakes.

Writers like this should be exposed for their total lack of understanding electronics. Even when you explain why a circuit does not work, they fail to comprehend the facts.

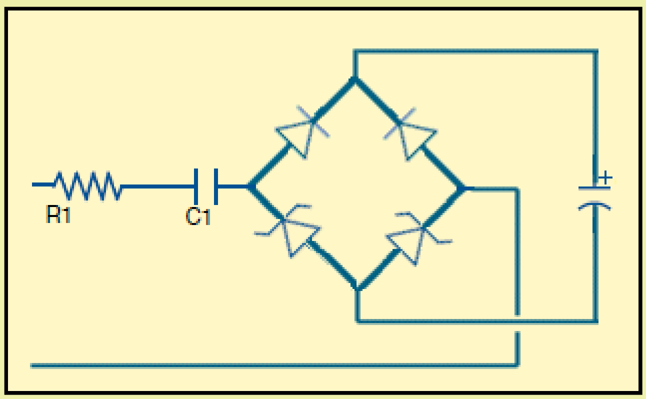
He has now provided a correct circuit. But no mention of the mess he produced in the magazine, messing up the readers who will try to get the circuit working.



Correct Bridge Circuit

But he still hasn't learnt how to draw a circuit correctly, so you can what is happening. It's no wonder he doesn't understand electronics.
I wouldn't understand electronics either if I produced jumbled circuits.

Here is the correct layout for the circuit so you can understand what is happening:



CORRECTLY DRAWN CIRCUIT

You can see the positives of the diodes are at the top and you can quickly trace through the circuit to see the two charging paths.
There is always one zener across the supply to create a maximum of about 12v (actually 12v - 0.7v). If you draw a circuit like this, you CANNOT make a mistake.

Here's another circuit from **Electronics For You** June 2015, that does not work:

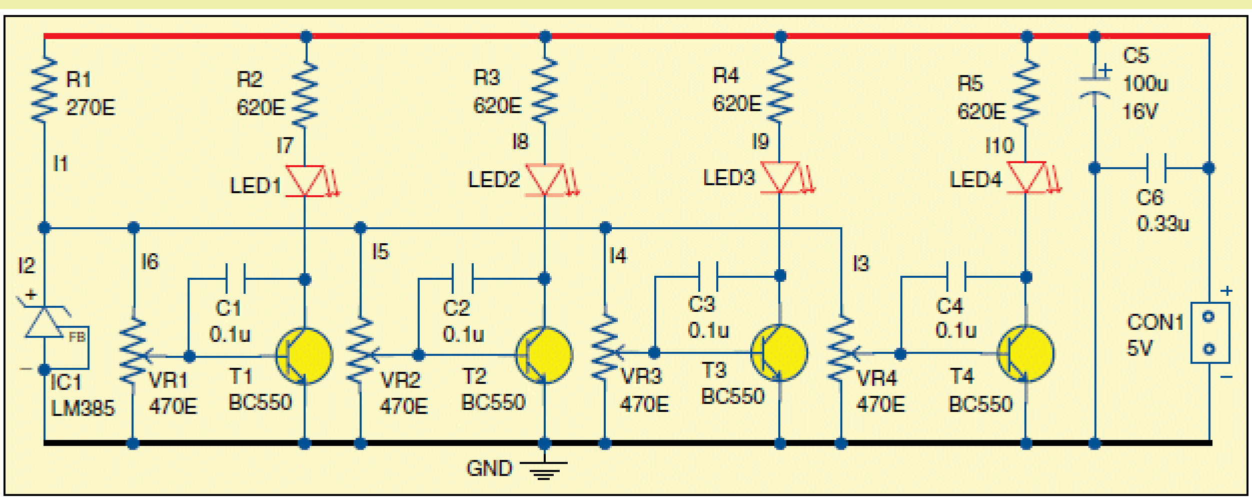


Fig. 1: Circuit diagram of the visual thermometer

The voltage on the top of the LM385 is determined by the 270R resistor and the four 470R pots in parallel.
The combined resistance of the 4 pots is 117R. The voltage at the join of the 270R and the 4 pots will be (5 / 387) x 117 = 1.51v The LM385 is an accurate voltage source that produces 2.5v. But ONLY 1.51v is available !!!!
Another untried, untested, circuit from: **Petre tzv. Petrov.**
Electronics For You never tests anything and most of the circuits they publish in their magazine DO NOT WORK or are too complex for the required task.

Here's another circuit from **Electronics For You** June 2015, that does not work:

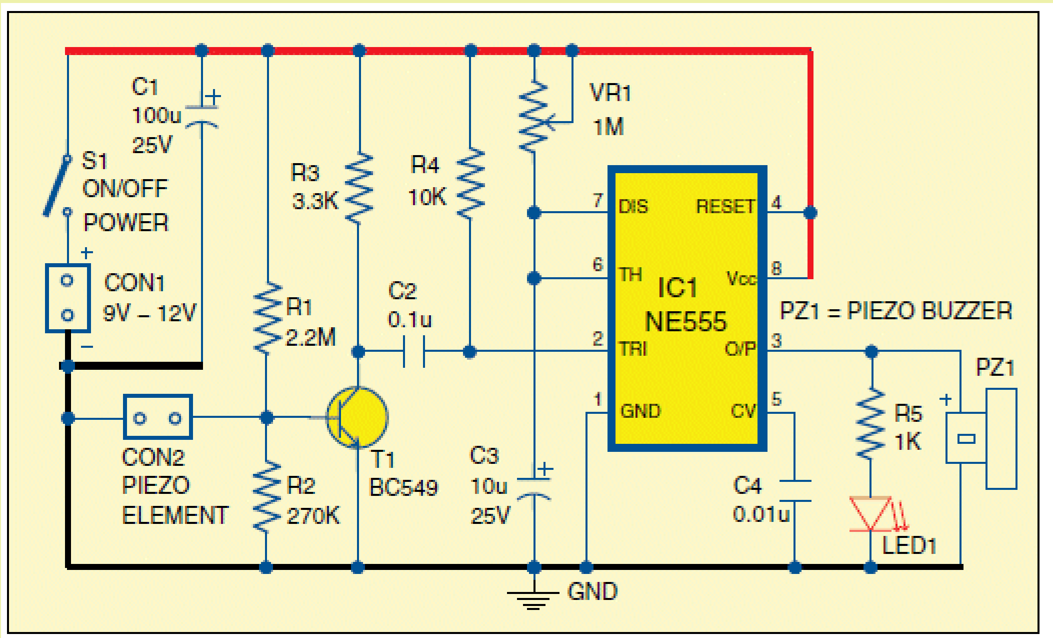


Fig. 1: Circuit of the glass break alarm

The biasing of the transistor will always produce more than 0.7v and it will be TURNED ON.
The 0.1u will be charged.
To activate the 555, pin 2 must be taken LOW and for 12v supply, this will be less than 4v.
In other words the 100n must discharge via the 10k and then the transistor must pull the 100n to a low voltage (before it gets charged again) so pin 2 activates the 555.
This is a very MESSY situation and the circuit is poorly designed.
Firstly the piezo has to work against the 2M2 to turn off the transistor. Then the 100n has to work against the 10k to pull pin 2 low before it gets charged via the 10k.
I would consider this circuit to be very unreliable in picking up the short sharp pulse of a breaking window.
In addition, if the pot is turned fully clockwise, pin 7 will create a short-circuit and damage the pot.

This circuit by D. Mohan KUMAR shows a complete lack of understanding of electronics.

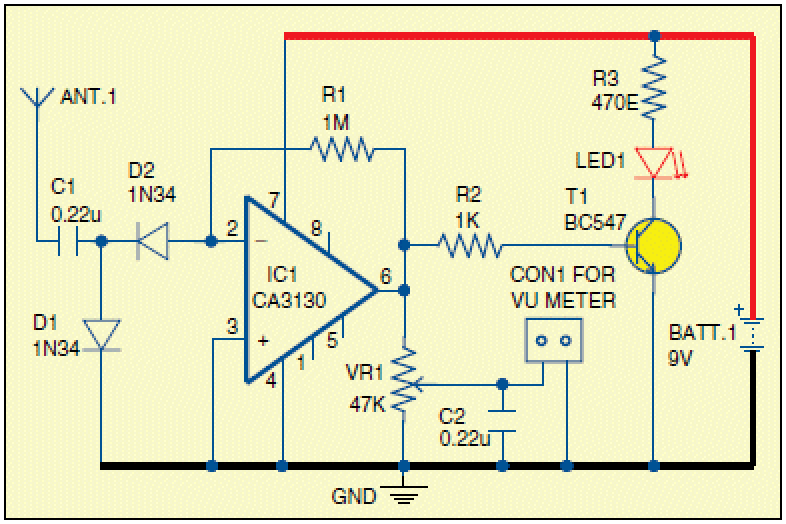
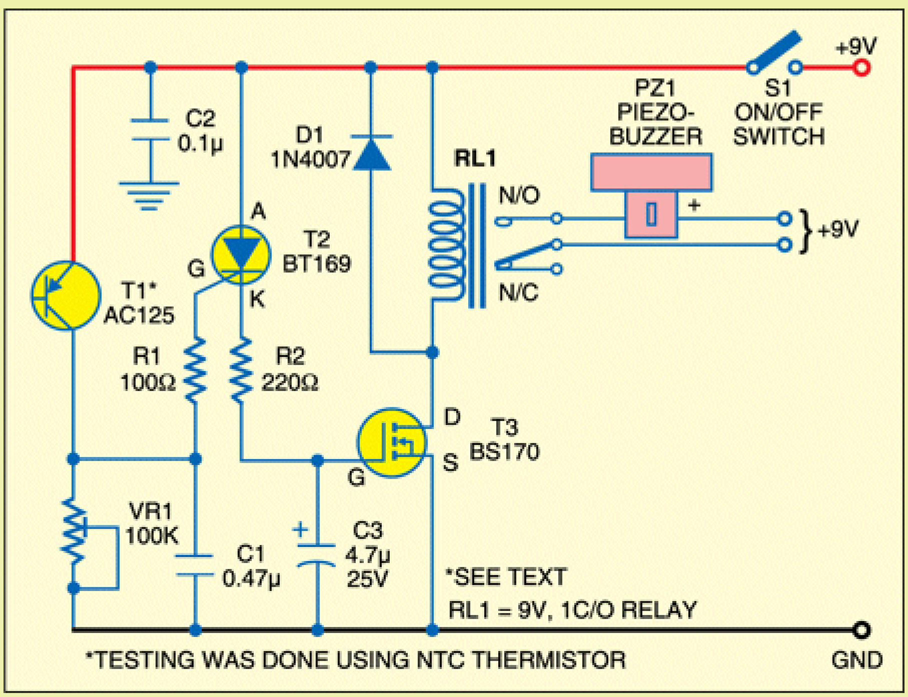


Fig. 1: Circuit diagram of the radio frequency detector

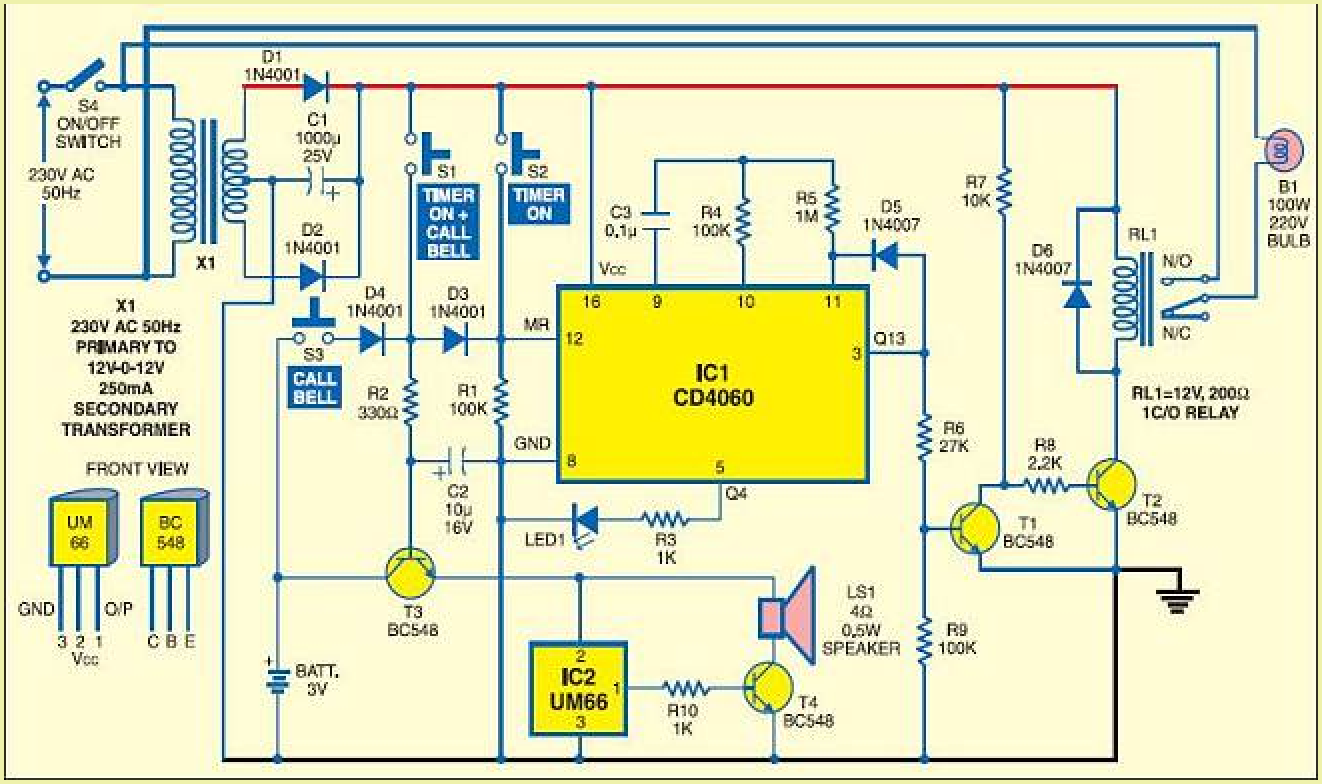
The 220n at the front end can be as low as 100p. It certainly does not have to be 220n as the front end is high impedance and the germanium diodes allow voltages as low as 200mV to be passed to the IC.
The impedance of 100p at 1MHz is 1k6 but if little or no current flows through the capacitor, little or no voltage will be dropped across it and thus it will produce little or no loss. So, any value above 1n is unnecessary.
It just shows the lack of understanding to use 220n. And of course, D. Mohan KUMAR has NO electronics understanding and produces a myriad of JUNK circuits that either do no work or use incorrect value components.
That's why it is so difficult for Indian students to get a good grounding in electronics, when you have magazines and "Professors" who publish rubbish circuits.

Here's another junk circuit from T. K Hareendran.



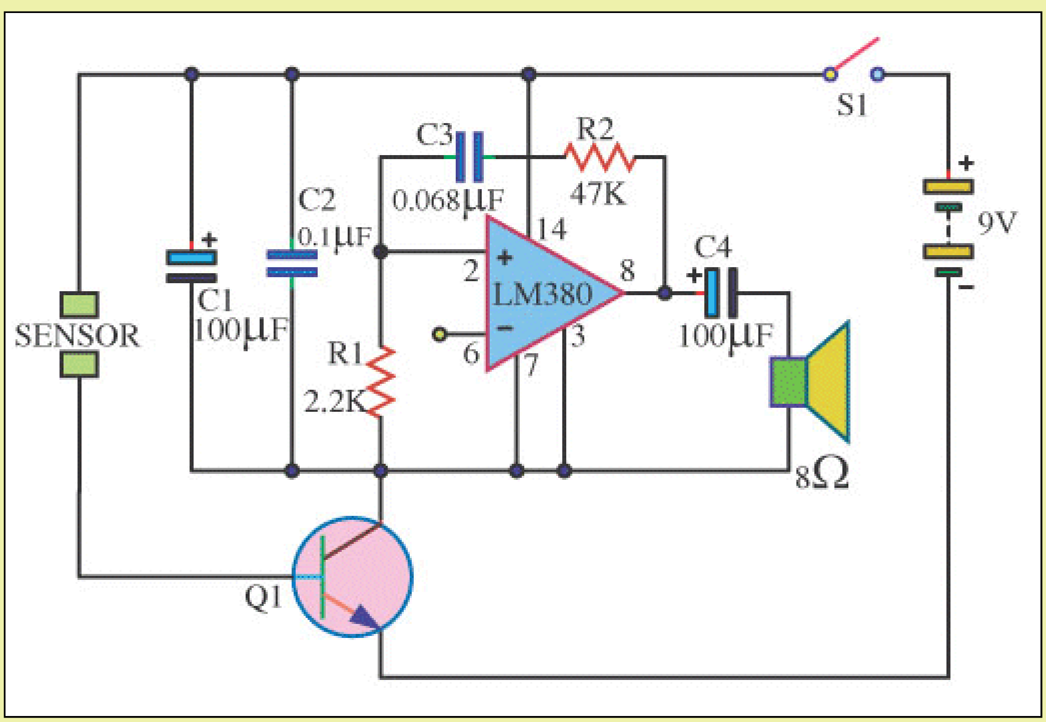
The main design-fault is the fact that the "k" of the BT169 is effectively 0v when the circuit is at rest and when the gate voltage rises, the "k" lead rises too and the BT169 has great difficulty in trying to turn ON.
It may turn ON due to the 4u7 slowing down the rise of the "k" lead but this is not the correct way to operate a thyristor.
Secondly, since we have turned ON the thyristor, we can use it to turn on the relay. So why use a FET to drive the relay ??
Where are you going to buy a AC125 germanium transistor?

Here's a stupid circuit from SURESH KUMAR K.B:



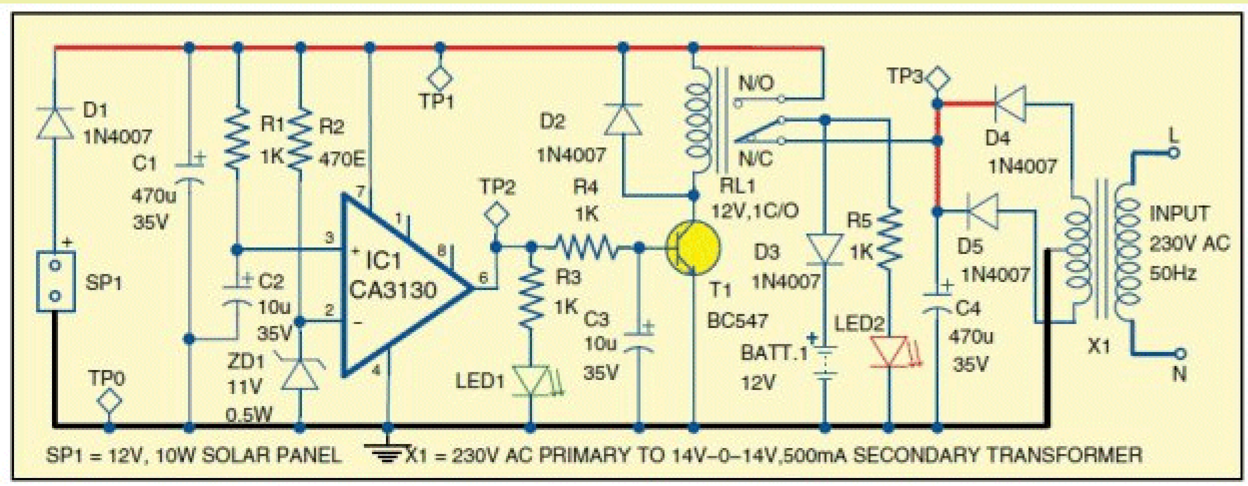
Why use a separate 3v battery when you have a transformer driving the circuit?
Why connect the speaker to 3v - 0.6v = 2.4v ???
Push the CALL BELL switch. What is it going to do??? T3 will turn ON with 2.4v on the base and 1.8v on the emitter. The UM66 and speaker will see 1.6v !!!!
Push the TIMER ON + CALL BELL switch and the base of T3 will see 17v and the UM66 will see 17v via 330R - It must not see more than 3v. What do you think will happen !!!!!!! There are other faults such as supplying more than 18v to the CD4060 and what's the purpose of R8 ? (2k2).
Just an untried, untested circuit from SURESH KUMAR K.B.

Here is a circuit that needs careful attention.

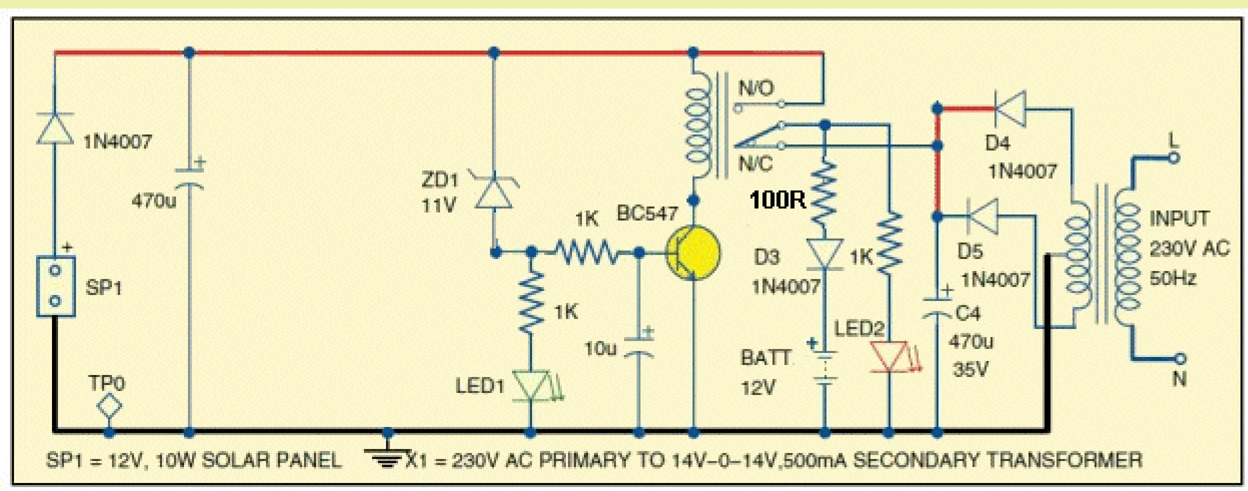


There is no information on the sensor. In fact there is almost NOTHING you can connect to the sensor connections.
If you connect a switch to the sensor connections, the transistor will BLOW UP !!! The current through the base-emitter junction will damage the transistor.
If you put your finger on the sensor pads, the transistor will not turn on sufficiently for the amplifier to drive the speaker.
In fact there is nothing you can connect to the sensor. Who designed the circuit ????

Here's another junk circuit from D. Mohan KUMAR

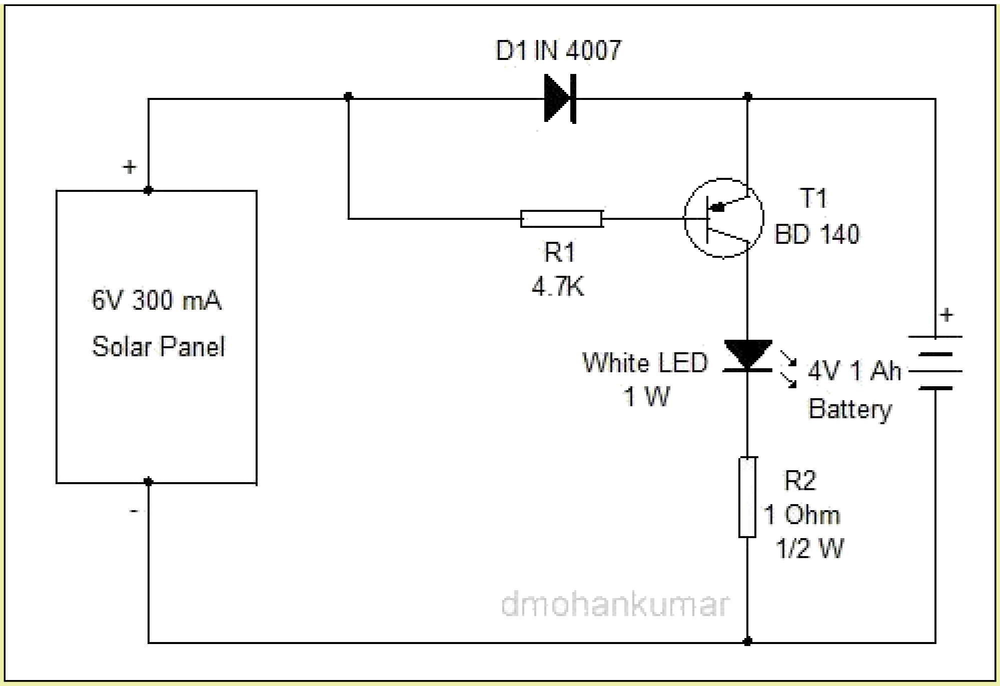


Two major faults with the circuit. Charging via the solar panel just needs a 11v zener connected to the transistor.
The output of the 14v transformer will be 20v DC and a 100R resistor is needed to prevent the current rising to more than 500mA.
The corrected circuit is:

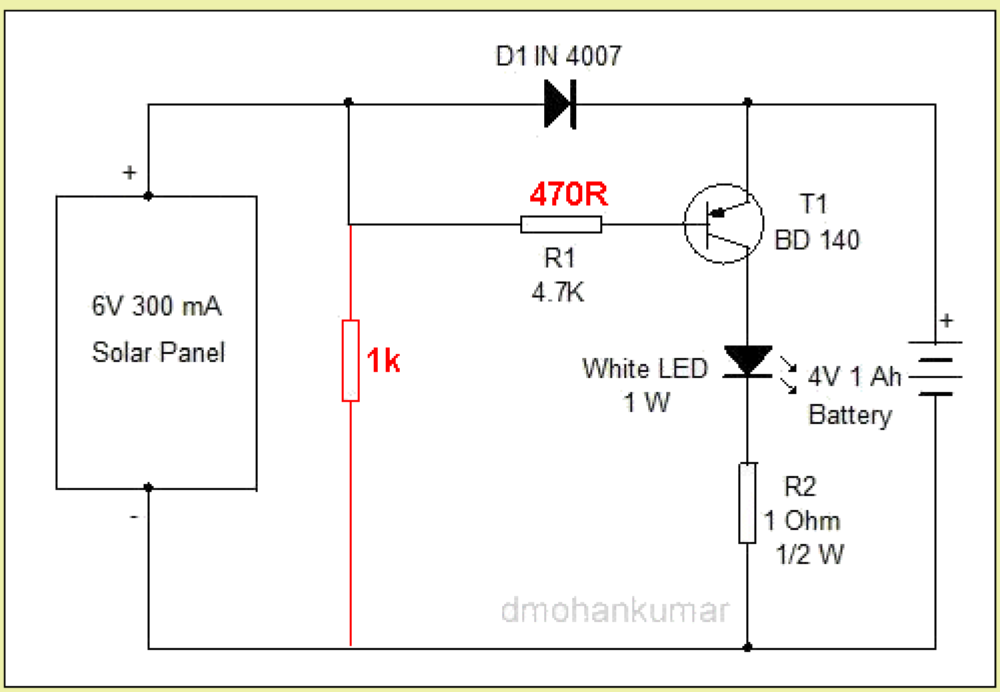


Electricity is so cheap. I don't see the point in buying a 10watt panel when the battery can be charged from the mains. 10 watts x 8 hours x 360 = $6.00 per year !!

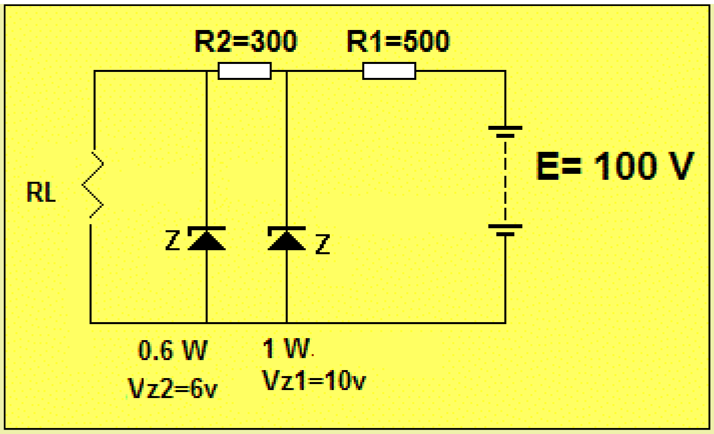
Here's another untried, untested, "dreamed-up" circuit from "Professor" D. Mohan KUMAR:



When a solar panel does not received any illumination, the output becomes ZERO but the resistance (impedance) across the terminals does not become a low resistance. It is effectively a very HIGH resistance.
The 1N4007 prevents the voltage from the battery entering the solar panel and delivering a small current. But this current is very small and when the battery voltage is less than the voltage that is capable of being generated by the panel, this current becomes EXTREMELY SMALL. Each 0.6v generated by the panel is derived from a sol cell and when a number of these are in series and not producing a voltage, the effective resistance to an incoming voltage is very high until the incoming voltage overcomes the "junction resistance" produced by each cell.
In the circuit above, the 4v battery was TESTED and it delivered NO CURRENT into a 5v or 6v solar panel.
This means NO CURRENT will flow in the 4k7 when the panel is not illuminated.
This mans the circuit will NOT turn ON during the night.
The circuit needs a 1k across the panel and the 4k7 needs to be 470R as shown in red.
This will allow about 3mA to flow in the base and if the transistor has a gain of 100, about 300mA will flow in the LED.
The original circuit WILL NEVER WORK.



Here is a homework question from an instructor:



The power rating and the zener voltage of the two zener diodes (Z1 & Z2) used in the circuit are 1 watt & 10v and 0.6 watt & 6v. Minimum zener current needed for the satisfactory operation of both zener diodes is 2 mA.
Find the range of RL values in which the circuit can be used as a voltage regulator.

The circuit is totally impractical and, as you will see, completely unworkable.

We start by seeing the 500R has 90v across it and this means 90/500 = 180mA will flow.
180mA will flow through the 10v zener and this means 10 x 0.18 watts will be lost in the zener. This is 1.8 watts and the zener is only a 1 watt device. It will BLOW UP.
Let's pretend it is not damaged.
The voltage across the 300R resistor is 10v minus 6v = 4v.
The current through the 300R resistor is 4/300 = 13.3mA
We can take 11.3mA for RL.
The resistance of RL = 6/.013 = 462 ohms.
RL can be 462 ohms or higher.

This explanation was removed from the FORUM because they do not like homework to be answered.
But after 2 weeks no-one provided any help and the value of the FORUM is WORTHLESS.
The fastest way to learn any subject is to be given all the answers.
You then have a choice of looking at part of the answer to see how you are progressing.
Obviously those in charge of the electronics forum have no idea how to teach.

LEVEL SHIFTER

A poor design by **Robert Penfold**.
This is not a **Level Shifte**r but a **Level Shifter** AND **Inverter**

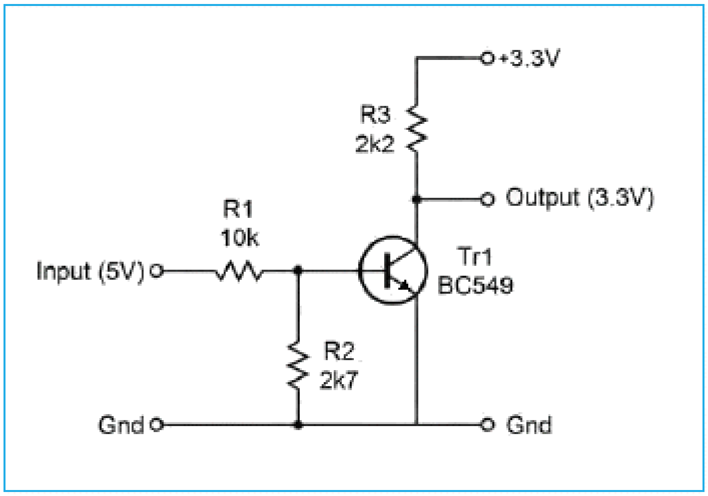
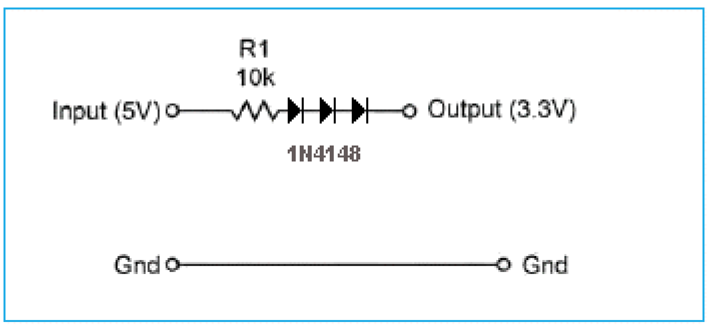


Fig.1. Where high operating speed is not required, a simple common-emitter switch can provide level shifting. Load resistor R3 is not needed if the input being driven has an internal pull-up resistor

Everyday Practical Electronics, June 2015

All that is needed is a set of 3 diodes to remove 1.8v from the 5v line to get 3.2v:



This circuit provides LEVEL SHIFT without INVERSION

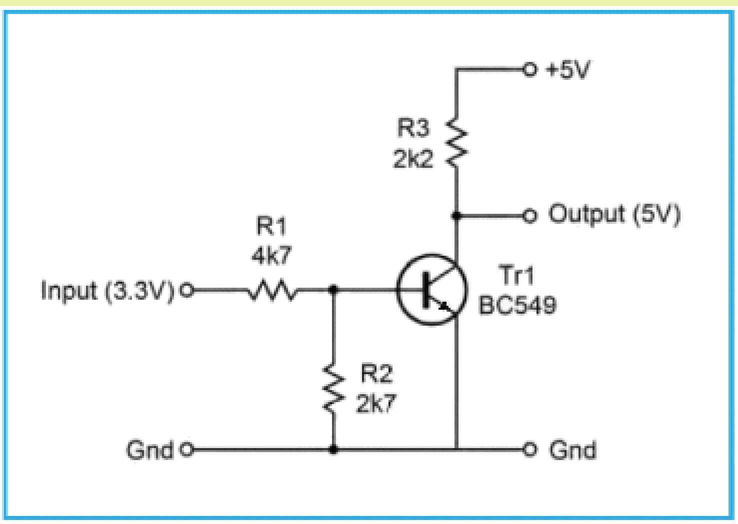
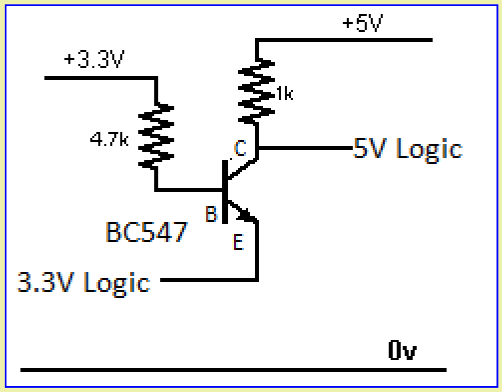


Fig.2. A common-emitter switch can also provide upward level shifting, as in this 3.3V-to-5V example. As before, this circuit is not suitable for high-speed operation

Figure 2 can be improved by designing a circuit that shifts the level but does not invert:



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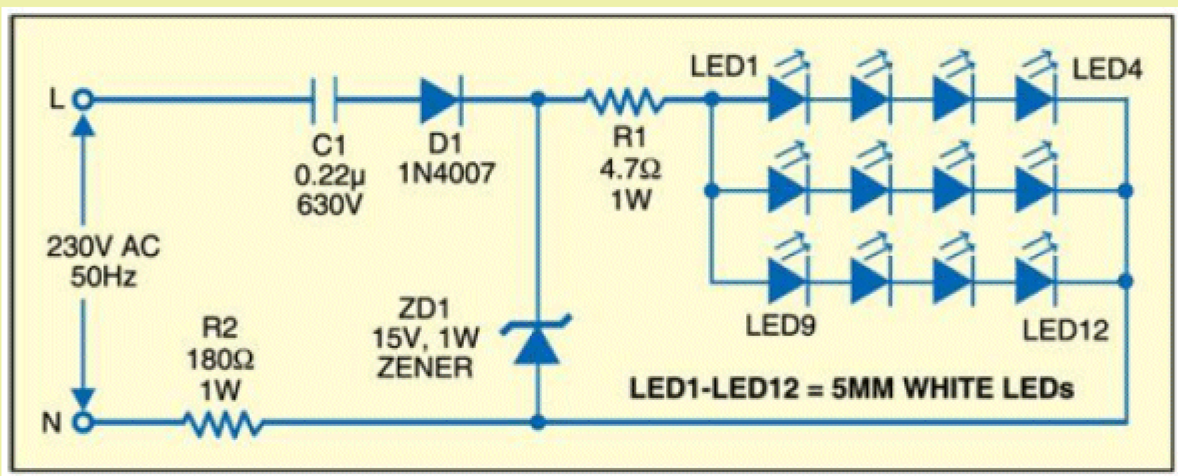
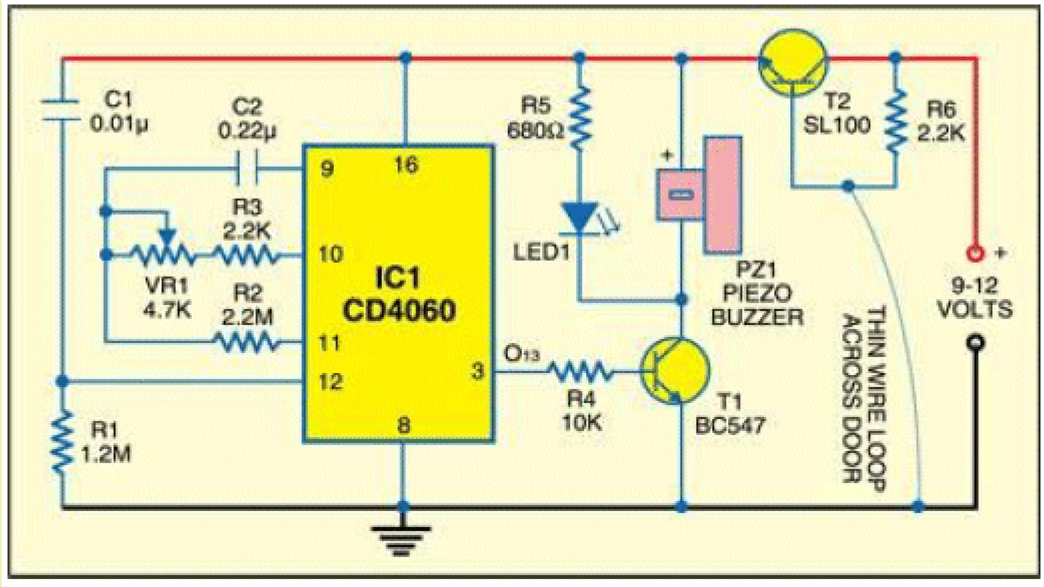
http://pictutorials.com/PIC_books.htm

LED LAMP



Two fault with this circuit. How is the 0.22u capacitor discharged? The zener should connect to the capacitor.
The 0.22u will deliver a maximum of 7mA. That's 2mA for each LED. How bright will they be???
Why use a zener when the capacitor-fed power supply is a constant current supply.
What is the point of adding the 4R7 ??
Just another useless circuit from **Electronics For You** magazine.

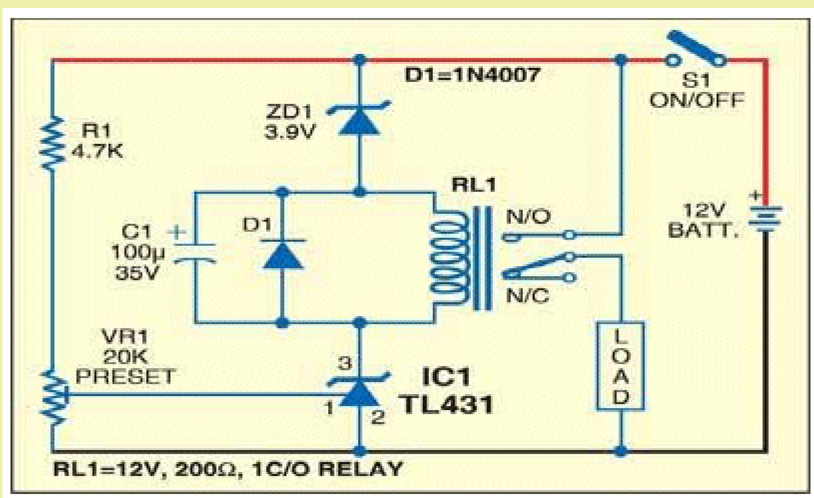
Here's another stupid circuit from Electronics For You.
The alarm sounds 30 seconds after the thief has broken the wire across the door.



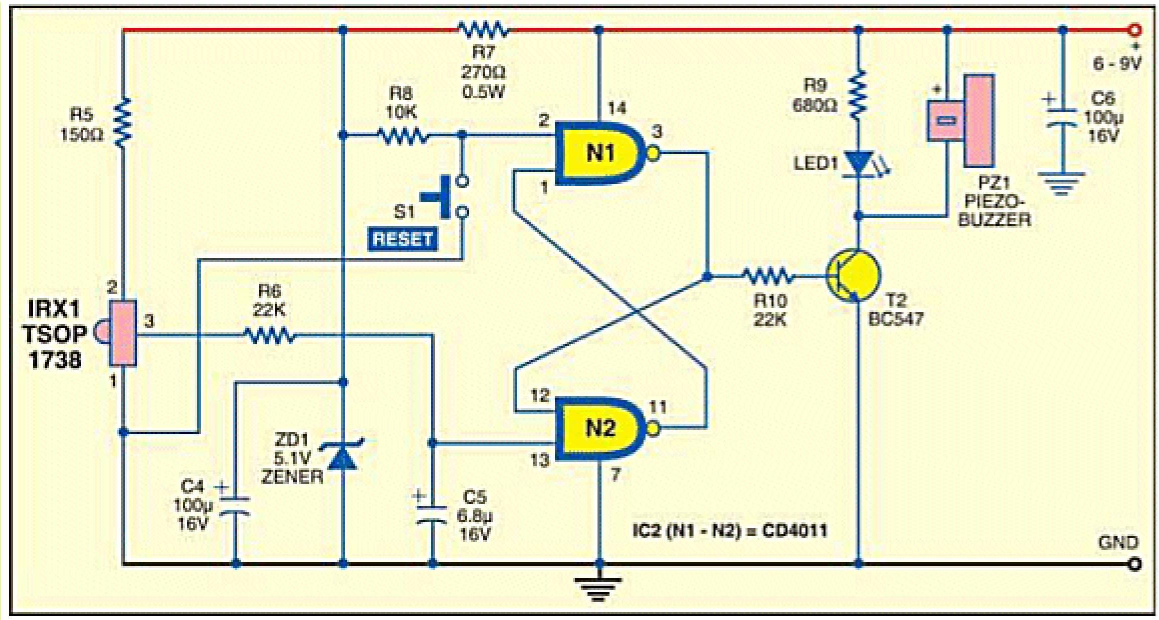
The circuit takes 5mA while sitting around. The battery will be flat in a few months.
The circuit could be re-designed to take a few microamps by freezing the oscillator of the chip.
Why sound the alarm after 30 seconds ??? The circuit is useless !!!!

BATTERY PROTECTOR

The life of a battery dramatically reduces when it is discharged below the minimum recommended voltage.
This circuit switched off the load when the battery falls to a certain voltage.



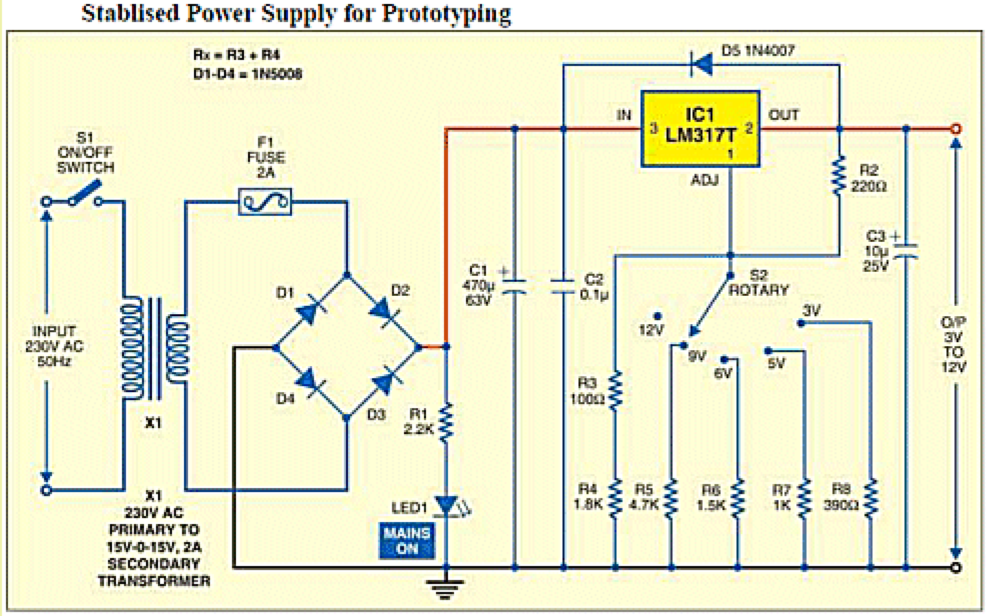
The circuit is too complex. It just needs a zener diode and a relay. You can include an ordinary diode if you want to decrease the set-voltage by 0.6v.



Not a well-designed circuit.
The supply voltage to the IC is 9v. The voltage on the inputs to the gates should be close to 9v to guarantee the IC registering a HIGH.
The TSOP1738 takes a few milliamp and the voltage on pin 2 will be less than 5v. The voltage on pin 13 will also be less than 5v and it is getting very close to the point where the chip will not detect the voltage as a HIGH. A chip really need 66% of rail voltage (nearly6v in this case) and less than 5v is going to be doubtful.
Another circuit from **Electronics For You**, designed by a reader who has little or no understanding of electronics. Anyone building this circuit would have a hard time detecting why it does not work.

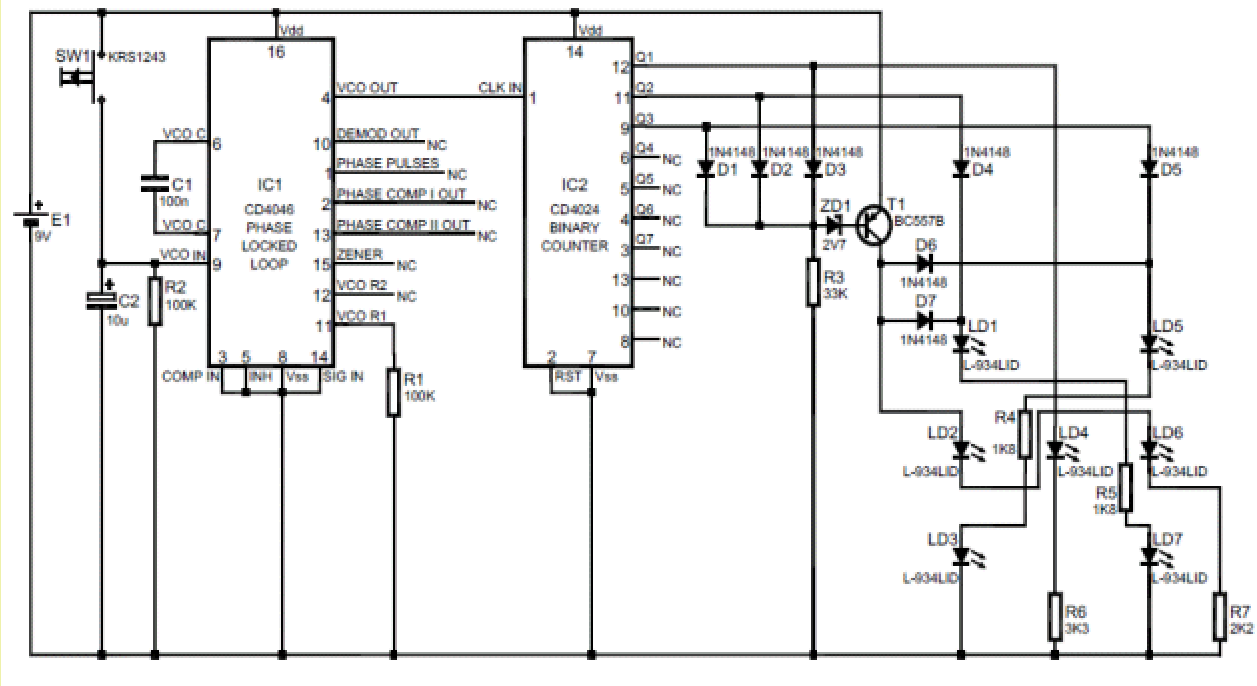
POWER SUPPLY

Stablised Power Supply for Prototyping



This is a very BAD and DANGEROUS Power Supply because the output immediately rises to 12v when the switch is changed from one position to the next because the contacts become "open" during the switching-action and the power supply "thinks" you have chosen "12v."

DICE



Here's a faulty circuit from Velleman

If you go through the logic of the outputs of the CD4024 chip, you will find the sequence is 1, 2, 3, 2, 3, 4, 5, 6.
This is because there are 8 cycles of the first three outputs as 0,0,0 produces a HIGH from the transistor to turn on 6 LEDs and then there are 7 more combinations.
I have never seen a worse DICE circuit. Imagine if a player selected 2 or 3 to WIN.
He would "scoop the pools" and walk away with the jackpot !!

Reply from kit supplier:

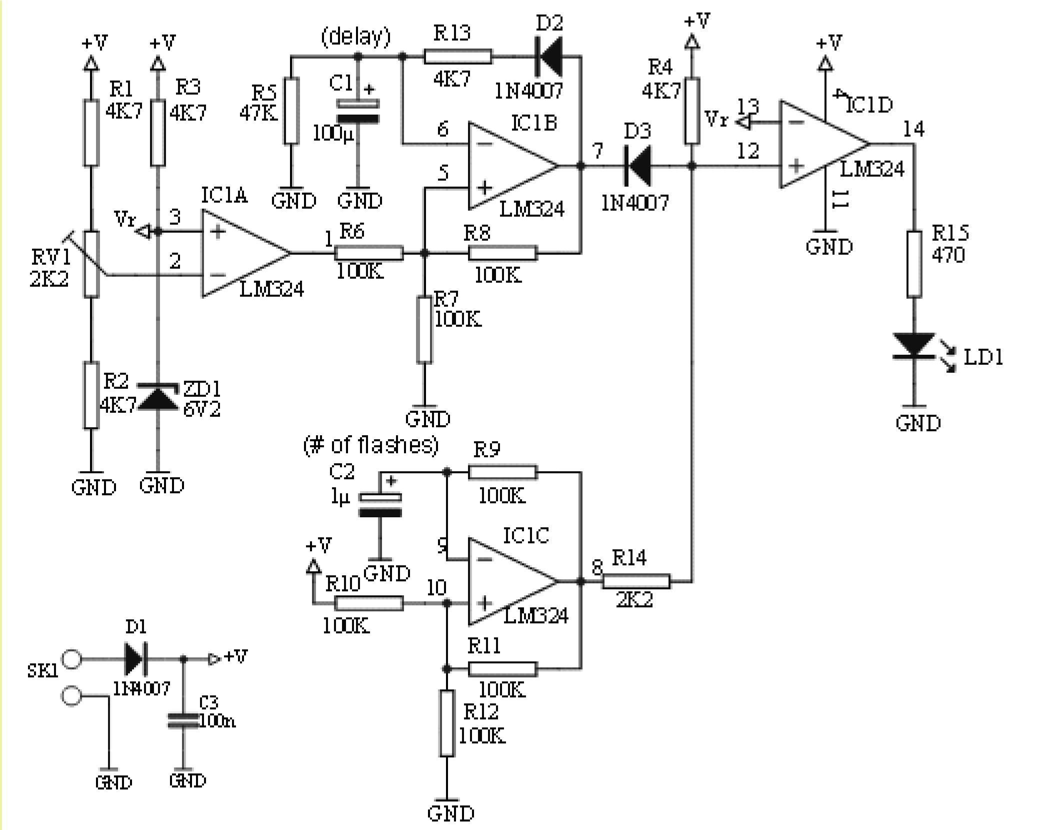
Yes, the kit is not a true random number generator, or even a pseudo-random number generator. It is meant only to simulate dice rolls. It has virtually no capacity to predict randomness.

My reply:
Why don't you say on the kit page that 2 and 3 will appear more often than the other numbers??

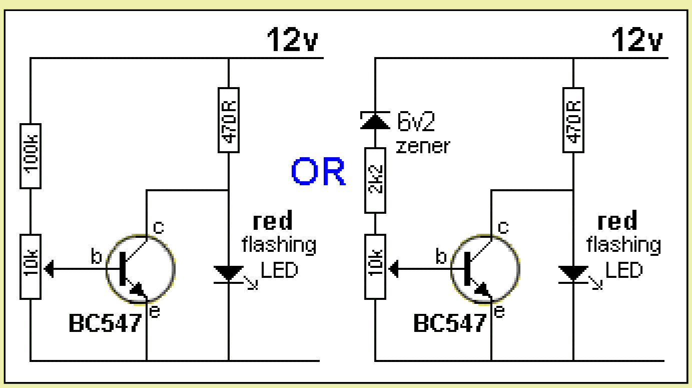
It probably doesn't matter for some board games, but if you are trying to make a DISTRIBUTION CURVE to test the randomness of electronics, the circuit will produce a big mistake.

CAR ALARM

Here is a Velleman Car Alarm. It relies on the fact that the voltage on the "electrical system" is slightly higher when the car is running due to the fact that the alternator is charging the battery.

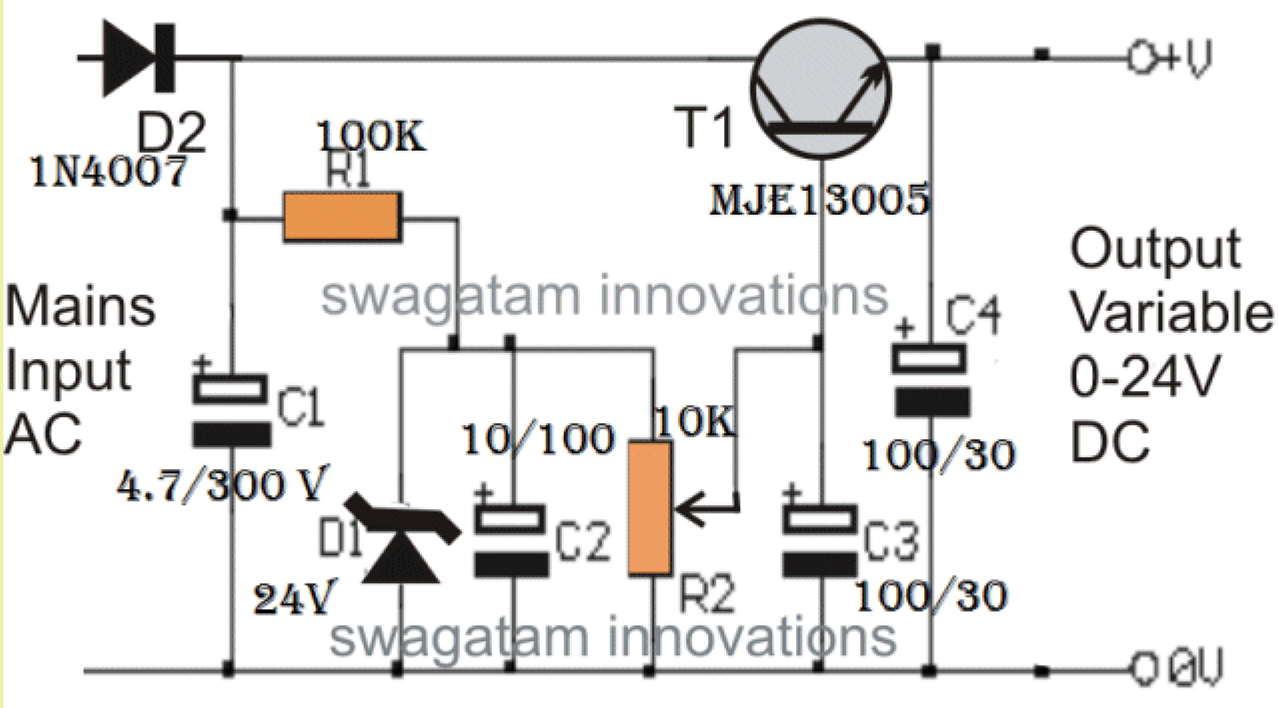


The whole circuit can be simplified to a transistor and RED flashing LED:



The two circuits above are an attempt to make it easier to detect the small change in voltage on the electrical system (across the battery). The second circuit puts a larger voltage-change across the 10k mini trim pot.
The skill in designing a circuit is to make it as simple as possible. Anyone can use a quad op-amp and 50 other components to flash a LED, but if you expect to have any chance of retaining your job, you need to keep things as simple as possible. Otherwise the opposition will come out with a simpler circuit.

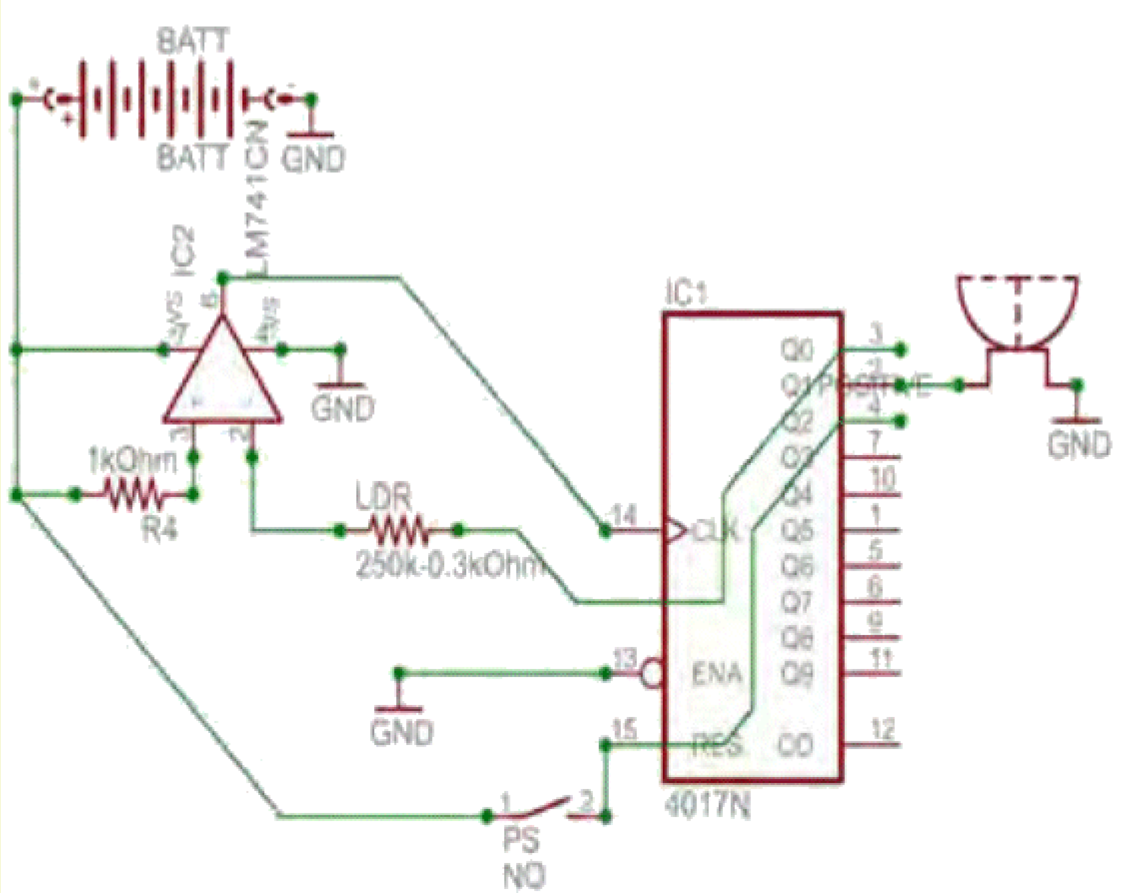
Here is another disastrous circuit from Swagatam.



The 100k and 10k resistors form a voltage divider.
If the Mains voltage is 240v, the peak will be about 300v and you will get about 30v at the join as the two resistors (as they have a ten-to-one ratio). The 24v zener will reduce this to 24v.
The current delivered to the combination will be about 3mA as 300v into a 100k resistor will deliver about 3mA.
24v across a 10k resistor will pass 2.4mA through the resistor. That leaves 0.6mA for the zener.
Now, here's the problem.
How much current can you "get out of" the 10k resistor ???
The 10k resistor in this circuit is not like any ordinary 10k resistor with 24v across it.
This 10k comes as part of a voltage-divider and only a maximum of 3mA is available.
To work out what happens is VERY COMPLEX but we will simplify the problem by using different values of resistance across the 10k and see what happens.
If you put a 10k resistor across the pot, the resistance will be 5k and we have to work out the voltage divider situation again. 100k and 5k will produce about 15v across the combination - that's because about 3v is developed across each 1k of resistance).
Immediately you can see the 24v has dropped to 15v and the zener regulator has lost its stability. THIS IS THE FIRST PROBLEM WITH THE CIRCUIT.
About 3mA will pass through the two 10k's in parallel and each 10k will pass 1.5mA. If we now remove the 10k resistor and try to deliver the 1.5mA to the transistor, here's what happens:
The transistor has a gain of 50 and this means it will deliver 50 x 1.5 = 75mA.
Another example:
If you put 1k across the 10k pot, about 3mA will flow in the 1k but the voltage across it will about 2v.
The whole circuit is absurd because if you want 3mA, YOU CANNOT GET IT because the voltage keeps dropping to ZERO !!!!

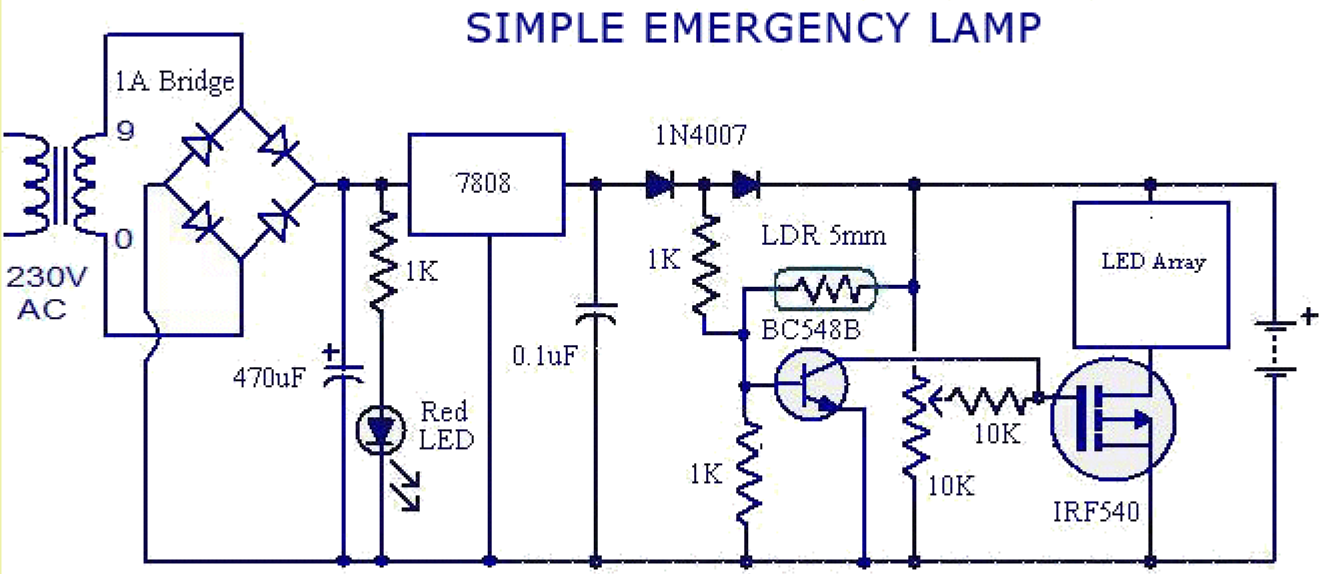
We have simply shown the circuit DOES NOT WORK and if SWAGMAN had built the circuit before making a fool of himself, he would have saved a lot of experimenters being frustrated.
Do not describe anything that has not actually been built, tested and used for a long period of time.
You need to try it with all sorts of load, all sorts of capacitors, all sorts of transistors to be sure it does not fail.
Very few people can "see" the failings in a design by looking at the circuit but these pages are designed to make you aware that this skill CAN BE LEARNED.

ALARM



Here's an alarm circuit with very poor design-features.
A 1k resistor on the input of an op-amp is not going to have any effect because the input is very high impedance and thus very little current will flow through the resistor and thus very voltage will develop across it.
The same applies to the LDR connected to the other input. The input pin is just like connecting the LDR to a nail hammered into a piece of wood. It is called a "floating terminal" or a "high-impedance pin."
The op-amp will detect a change in voltage on either of the inputs but they are just like two nails hammered into a piece of wood. They effectively "don't go anywhere."
If you want the voltage to change on either pin, you must create this change via a VOLTAGE DIVIDER.
If you have a 10k resistor from a 9v supply connected to a nail, the voltage on the nail will be 9v. If you increase the resistor to 1M, the voltage on the nail will still be 9v. Obviously you have to measure the voltage with a very high impedance meter, but it will be 9v.
The input to an op-amp is just like a nail. It does not allow any current to flow though the resistor and thus no voltage-drop is produced across the resistor.
Thus the change in resistance of the LDR will not change the voltage on the input of the op-amp.
In reality, some op-amps might draw a very small current and the voltage will change, but this is not something you can rely on when designing a circuit.
The third fault is the reset button connected to pin 15.
This pin is also connected to pin 4 and at the moment the chip is producing a LOW on pin 4.
It is not a good design to connect an output of a chip directly to the positive rail when it is in a LOW condition. This is called a "conflict" and even though it might not damage the output, it shows poor-design.
The circuit is obviously not designed by a knowledgeable person.

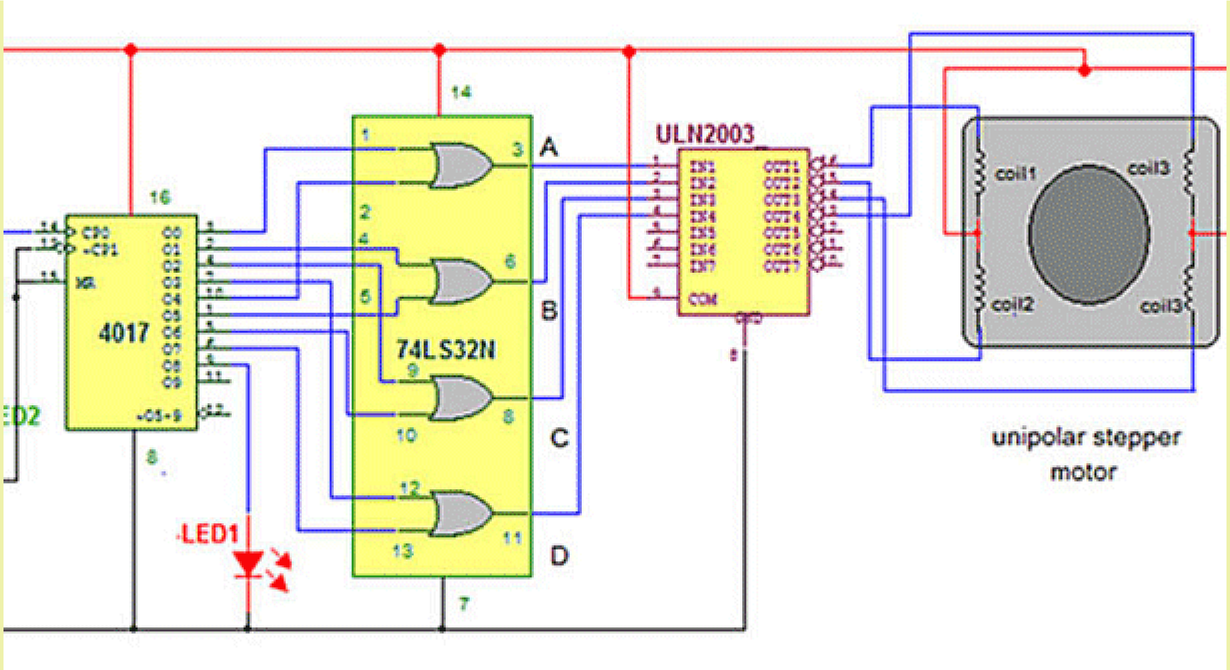
EMERGENCY LIGHT



Here's an untested circuit that does not work.
The transistor has 1k on the base and about 6mA will flow. This means the collector-emitter circuit will allow up to 600mA and the transistor will be FULLY TURNED ON. The voltage across the collector-emitter terminals will be about 0.2v This means the gate will never rise above 0.2v.
Another way to look at the circuit is this:
The base resistor on the transistor is 1k.The transistor has a gain of 100 and it reduces the 1k to 1,000/100 = 10 ohms!! The transistor is just like a 10R resistor between gate and 0v rail.
The 10k gate resistor and 10R (to 0v) creates a voltage divider that never allows the gate voltage to rise.

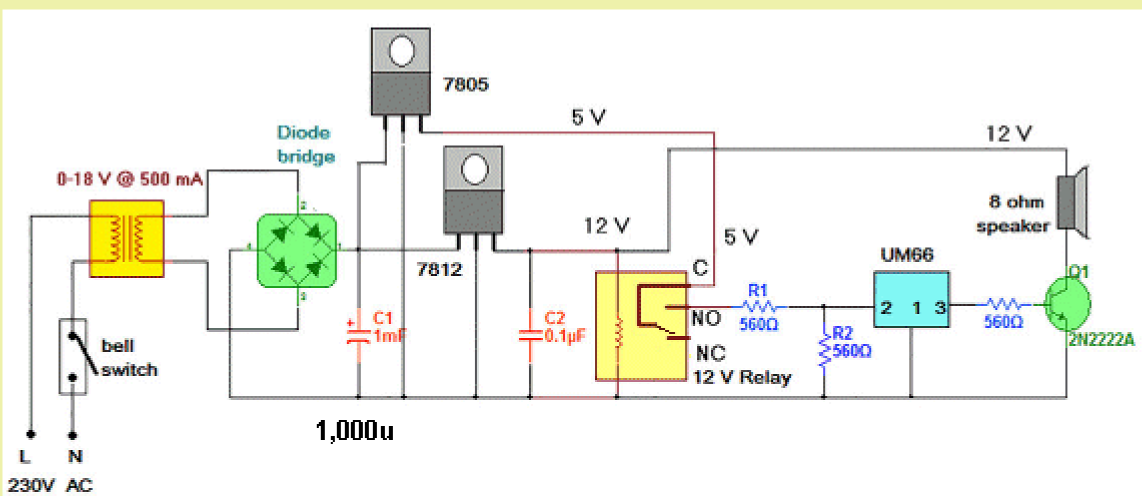
Here a book with 100 simple projects. They have been copied from different magazines and some circuits have faults, but it's a good book for ideas: MINI ELECTRONIC PROJECTS

UNIPOLAR MOTOR



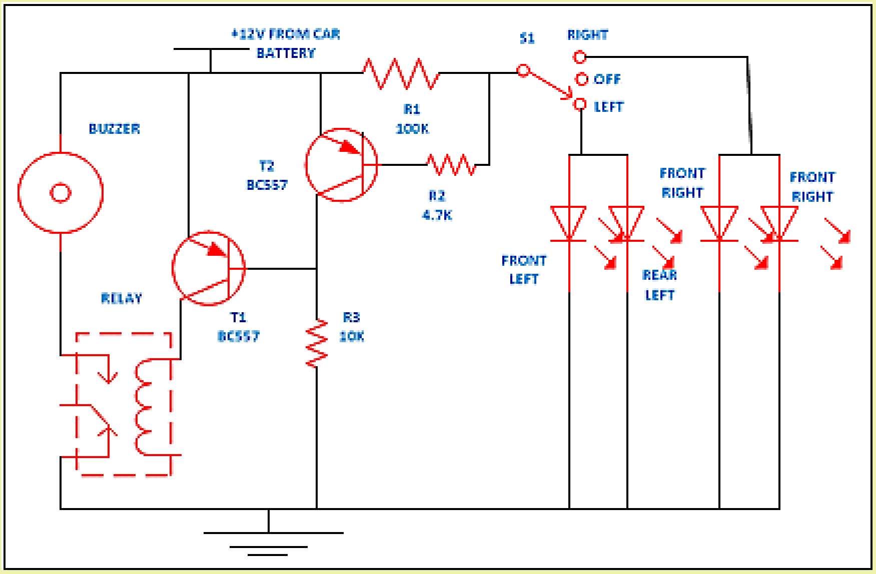
This discussion is to show why it is important to analyse each and every component in a circuit and decide if it is not needed.
I have previously shows the fault in a circuit that had 3 extra components and if you are making 100,000 units, this can represent a considerable cost.
The middle IC is a quad OR gate and the output of the 4017 drives A, B, C, D then A, B, C, D HIGH The middle IC can be removed and the first 4 outputs of the 4017 taken directly to the ULN2003 IC and after the 4th output does HIGH, the 4017 is reset and the cycle repeats.
I don't think the rest of the circuit works efficiently anyway, but that is for another discussion.

DOORBELL



Here's a lesson how NOT to design a circuit.
Firstly, the bell switch is in the 230v line. No bell-switch is designed for 230v.It is designed for 12v.
What is the point in turning ON the 5v supply to the IC via a relay? When the switch is pressed, all the components can be activated via very simply circuitry.
The chip is designed for 3.5v. The voltage divider will produce a maximum of 2.5v
But when you look at the output, you see the output-to-ground is 560 ohm and because the supply is derived via a voltage divider, the 2.5v will be reduced further to about 1.7v MAX.
The voltage divider for the chip is classified as a HIGH IMPEDANCE SOURCE because any load on the output up to about 4k7 will reduce the supply noticeably.
The 5v regulator is not needed. The 3.5v can be derived from the 12v regulator using 100R and 39R resistors.

TURNING INDICATOR



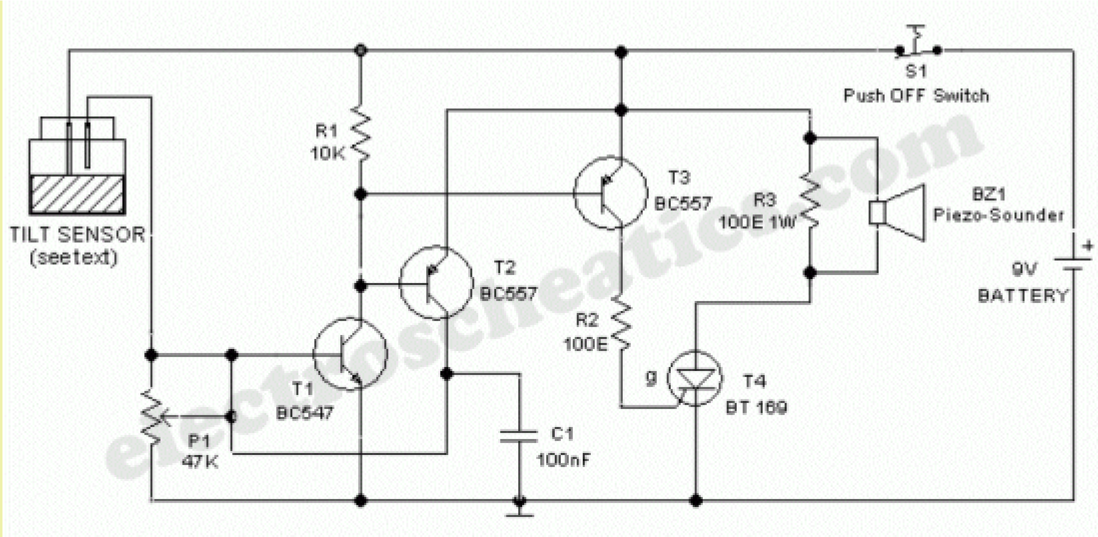
Anjali Sethiya

Here is the description of the circuit according to **Anjali Sethiya**:

When you on the switch S1 for indicator of right or left side this will cause the voltage drop across resistor R1. This will drive the transistor T2 into conduction. And Transistor T1 also conducts which energise the relay and the buzzer connected to it start sounding. If you want you can connect your car indicator light lamp in place of LED's. Take care while using the value of resistor R1. It should be chosen according to requirement like if you are using LED its value may vary from 100 ohms to 1 K ohms.

Can you see the BIG MISTAKE?
Transistor T1 is ON all the time and is turned OFF when the LEDs are illuminated.
The turning LEDs should FLASH. The circuit does NOT DO THIS.
The LEDs are turned ON via the 4k7 resistor. They only get 2mA !!!!
R1 should be 100R to 470R NOT 100k.
This is a useless circuit. It is too complex and does not flash the LEDs.

TILT SENSOR CIRCUIT



Let me explain why this is the worst circuit on the internet. Not only has it been designed by

T.K.HAREENDRAN who states he is a "professional electronics engineer" with many circuits in many magazines, but it will blow up the transistors.

The circuit starts by connecting the battery and the 100n prevents voltage appearing on the base of the base of the first transistor.
This means the first transistor is not turned ON and both T2 and T3 are not turned ON.
When the tilt sensor allows current to flow into the base of the first transistor, it is turned ON
The tilt sensor will only turn it on a small amount and will not damage the transistor.
But as the transistor turns ON, a voltage develops across the 10k resistor and this allows T2 to start to turn ON.
It turns ON with a small amount of current into the base but 100 times more current flows in the collector-emitter leads and this current begins to turn on T1.
T1 now receives 100 times more base current and this action continues until both transistors are fully turned ON.
There is no current limiting resistor in the circuit and both transistors WILL BLOW UP.
At the same time T3 is turned on FULLY and it has no current-limiting resistor and it will BLOW UP TOO.
This makes it with worst circuit on the web.

DOOR ALARM

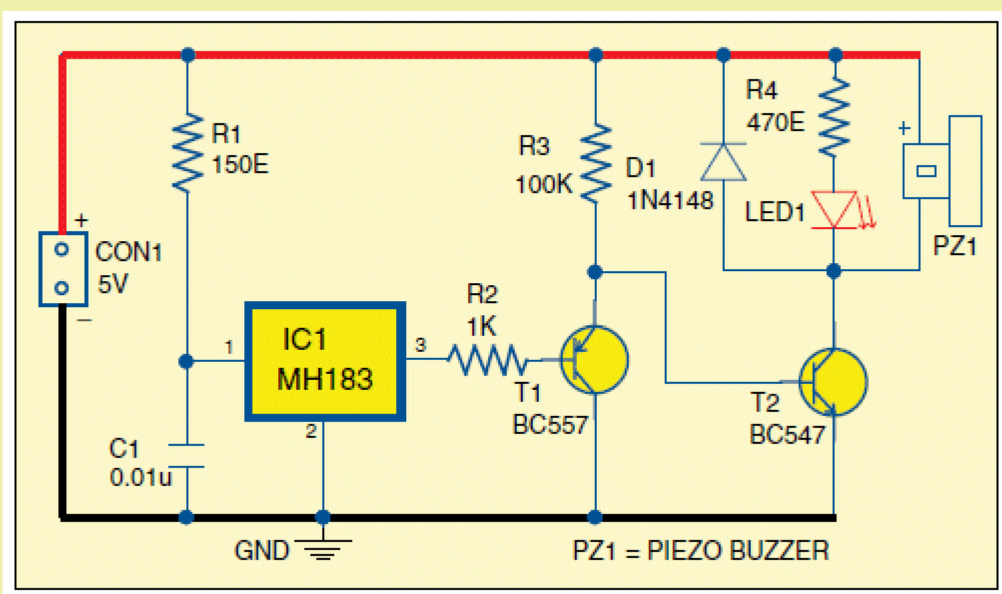
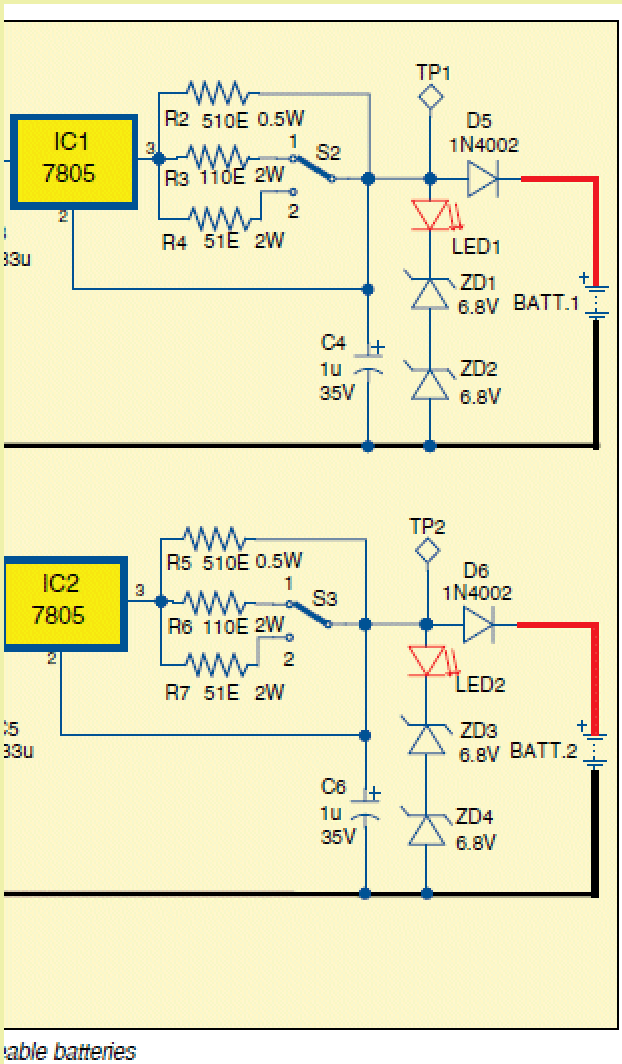


Fig. 1: Circuit diagram of the door-opening alarm

When will **Electronics For You Magazine** stop publishing JUNK circuits?
If pin 3 is at 0v, the voltage on the base of the PNP transistor will be 0v. The emitter will be 0.6v. This 0.6v will be

passed to the NPN transistor and it will be turned ON all the time.
The BC557 is an emitter-follower and the emitter is never less than 0.6v and the piezo will never turn OFF. This is simple, obvious, basic electronics. EFY doesn't have any technical staff to see this fault. And yet they are running an electronics magazine in India - a country that says they are up with the latest technology!!!

BATTERY CHARGER



The 7805 regulators are in CONSTANT CURRENT or CURRENT LIMIT mode and this means the output will rise and rise and rise until it reaches the input voltage (less 3v). This will happen when the battery is removed and on the output are two zeners and a LED.
These three components create a fixed voltage across them and the voltage cannot rise above 6.8v + 6.8v + 1.7v = 14.3v.
The 7805 is capable of delivering 1amp and the circuit reduces this current but it is still sufficient to damage the LED and when the battery is removed **POOF!** The LED blows UP !!
No-one at **Electronics For You Magazine** understands electronics and all the readers are delivered this sort of rubbish.

DOG KENNEL LIGHT

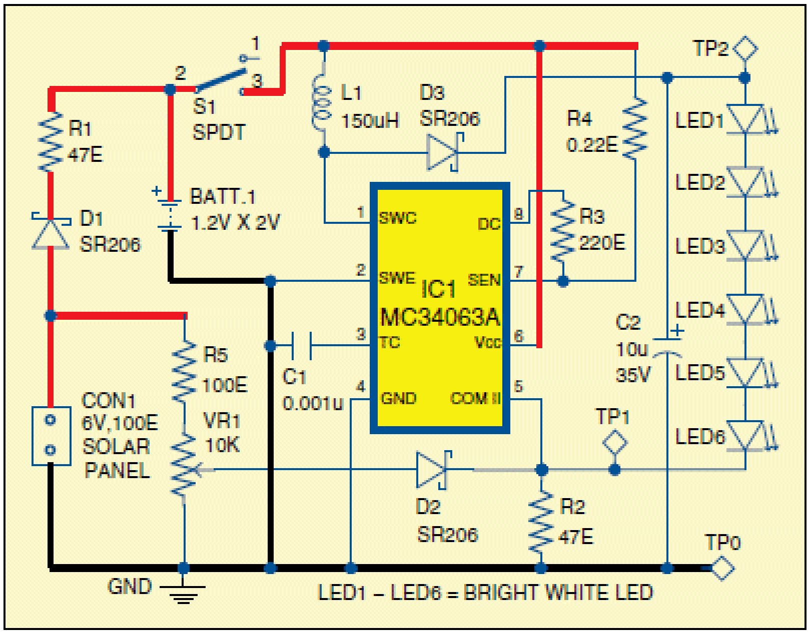
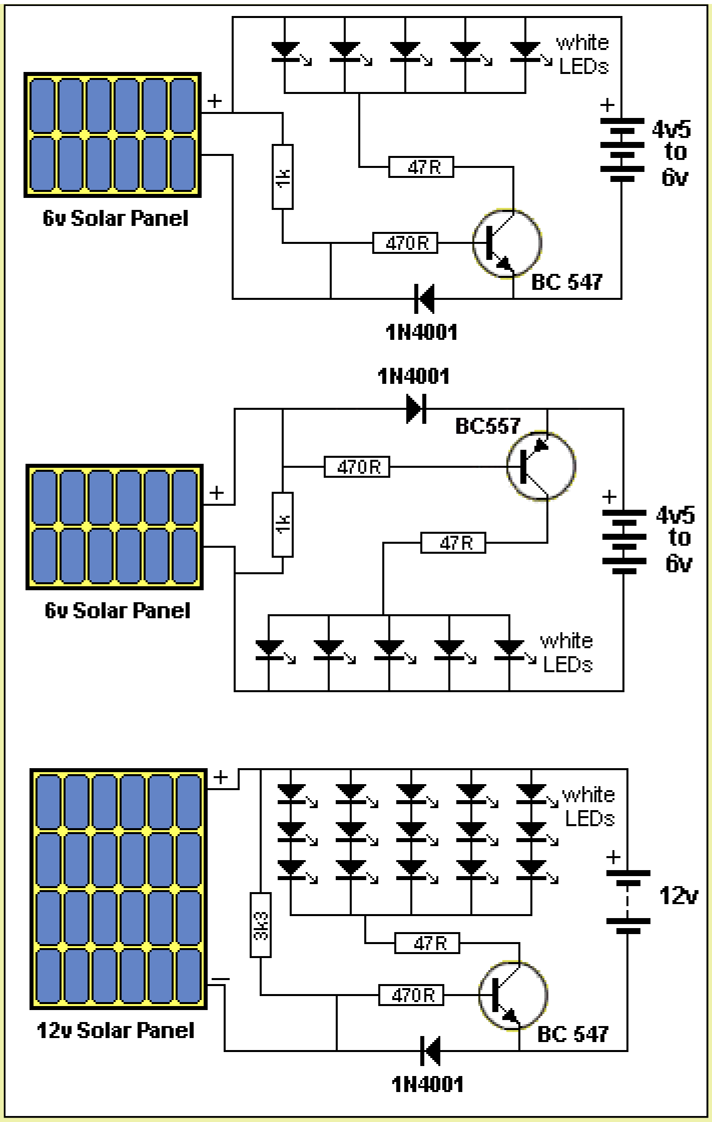


Fig. 2: Circuit diagram of the solar-powered kennel light

The above circuit from **Electronics For You Magazine** DOES NOT WORK. The chips requires a minimum of 3v. It has almost no capability at 2.4v.
What is the purpose of R1??
What is the purpose of R4 ??
R4 is called a SENSE RESISTOR and it detects a small voltage across it when a high current flows. It has a very low value so it does not reduce the voltage to other parts of the circuit. In other words, there must be a LOAD on the end of the resistor.
In this circuit the "sense" input is HIGH IMPEDANCE and almost no current flows though the 0.22R. It is pointless including this resistor in the circuit.
T.K.HAREENDRAN has no idea about impedance-values and doesn't know how to design a circuit FOR NUTS.
Can you imagine buying all these exotic components for a DOG KENNEL LIGHT ! What does a dog need a light for? Does he read in bed????

The circuit can be simplified to:



The secret of a good design is to keep everything simple and use readily-available components.

Here is a circuit sent in by a reader:

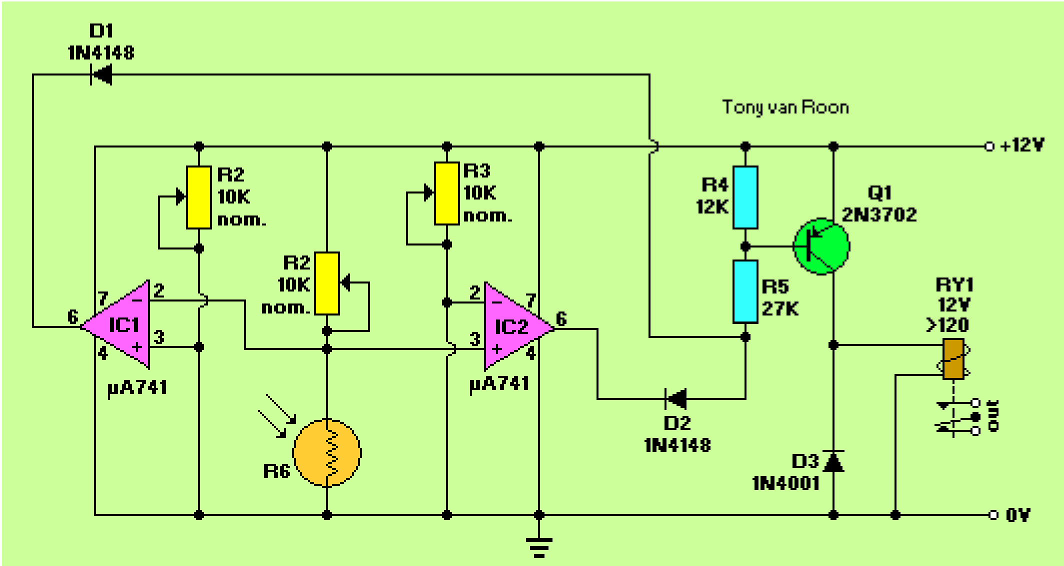


Fig. 10 -- Combined light/dark-activated switch with a single relay output. Value of R2 equals R6 at normal light level.

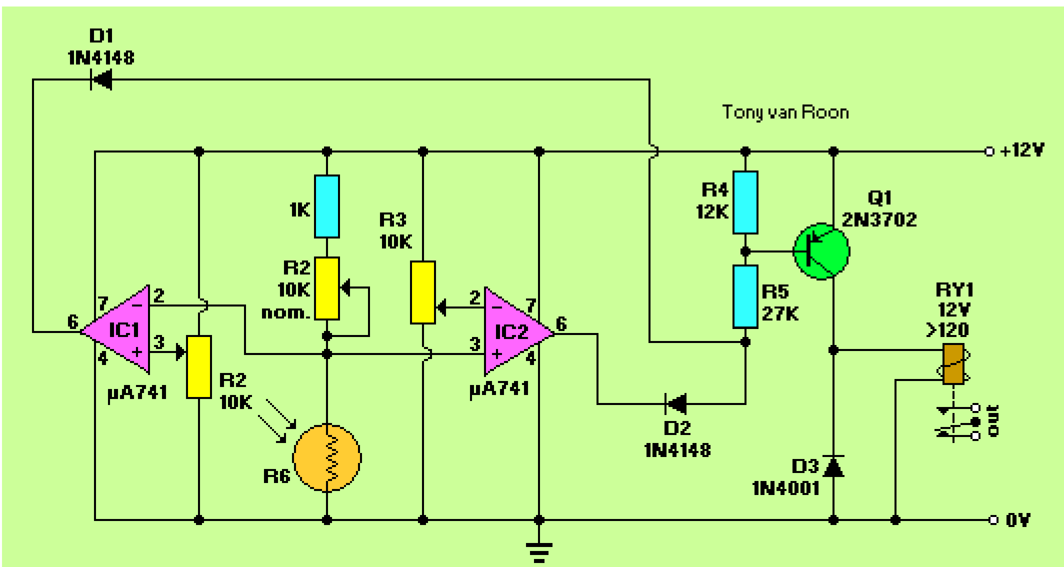
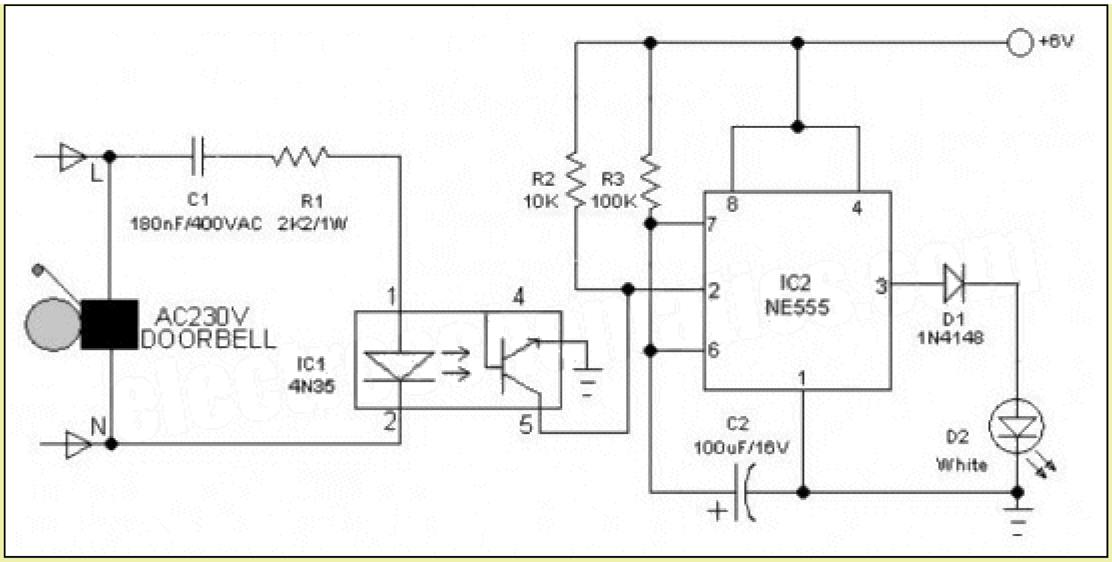


Fig. 10 -- Combined light/dark-activated switch with a single relay output. Value of R2 equals R6 at normal light level.

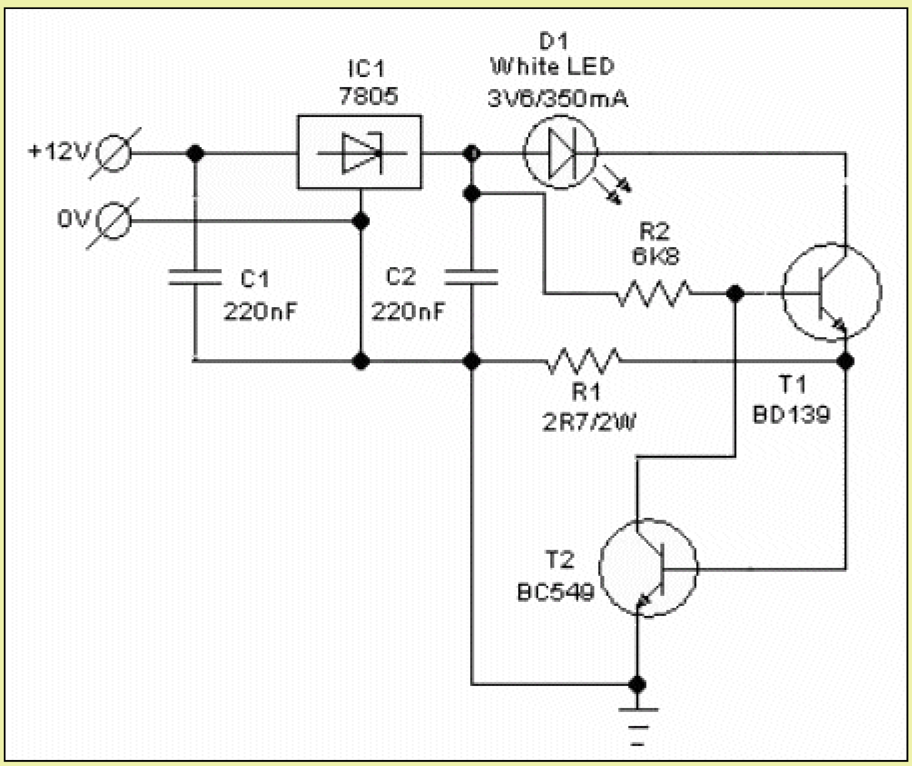
If the 10k mini trim-pots are turned fully clockwise, the very small resistance between one end and the wiper will cause a very high current to flow and they will be burnt out. The second diagram shows how the trim-pots should be connected to prevent any problem.
A 1k safety resistor can be added to the trim-pot connected to the LDR if you have a type that produces a very small resistance when detecting very bright light.

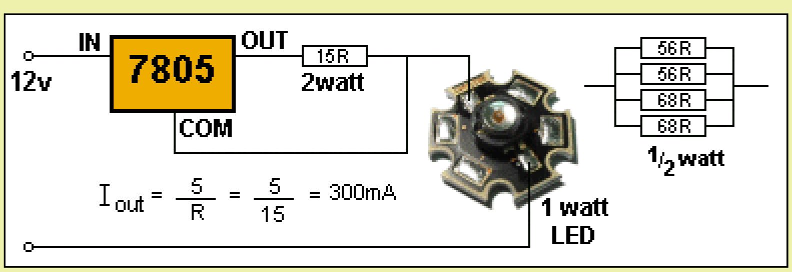
DOORBELL
Another disaster by **T.K.HAREENDRAN**



The LED inside the opto-coupler will see 250v or more as a reverse voltage and BLOW UP!
No current limiting resistor for the white LED.

CAR LED LIGHT
Another disaster by **T.K.HAREENDRAN**
This circuit can be replaced with a single resistor!!!!!!!

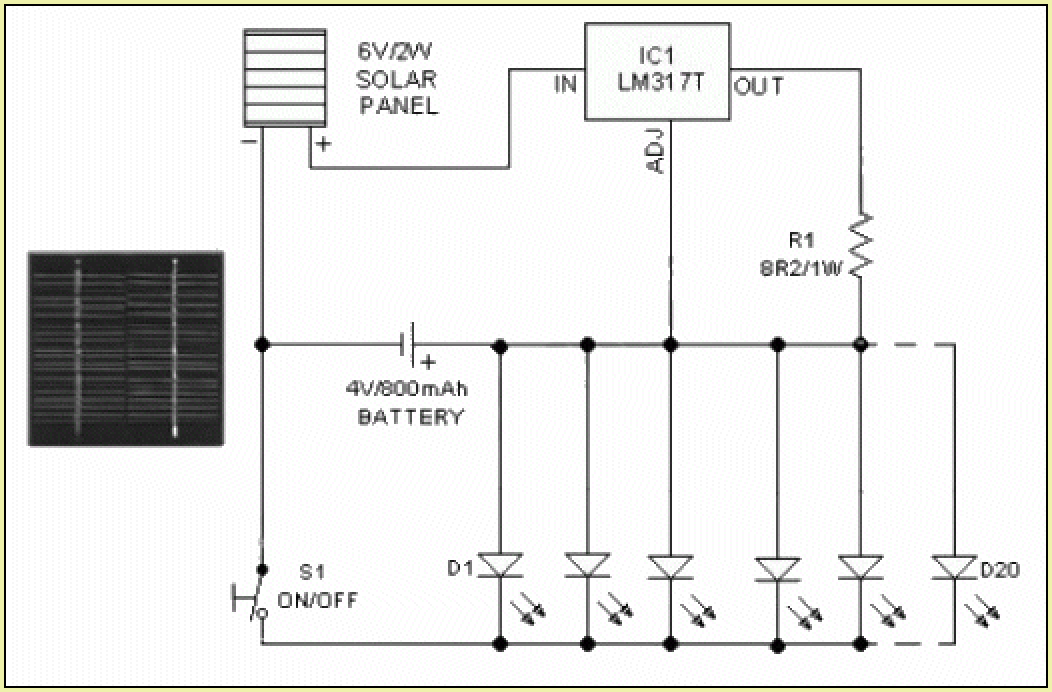




Before you start to design ANYTHING. Look on the web for circuits and see what has been done by PROFESSIONAL ELECTRONICS ENGINEERS.

This applies to ANYONE designing ANYTHING.
It will save a lot of embarrassment.
It is obvious that **T.K.HAREENDRAN** does not have a clue about designing a circuit and yet he keeps putting his rubbish into magazines and on the web.
And he keeps annoying me with rude emails about how incompetent I am !!!
I may be incompetent but no-one has emailed me to explain where my incompetency is or where I am wrong.
Until that time comes, you will just have to believe these corrections are factual.

SOLAR CHARGER
Another disaster by **T.K.HAREENDRAN**



You don't need the LM317. The small solar panel will not overcharge the battery. But if you get more than 5 hours sunlight, you can add a 22R to 47R in series with the solar panel to reduce the charge-current.
The solar panel needs to produce 4v plus 1.2v called the "floating charge" produced by the battery when it is being charged, plus a small voltage dropped across the 8R2 (1v) plus 2.5v dropped across the LM317. This means the solar panel must produce more than 8.7v so that a current will flow.
Remember this: At 8.7v NO CURRENT will flow because the solar panel is producing exactly the same amount of voltage that is "developed" by the circuit. It is a bit like connecting a 9v battery to another 9v battery. No current will flow from one battery to the other because the voltages are the same.
If the solar panel produces 9v, a current will flow according to the "overhead voltage" of 0.3v. The amount of current cannot be worked out because this current flows through the cells of the solar panel and these cells have a resistance or "impedance" that will limit the current.
So, the solar panel has to produce A LOT MORE VOLTAGE so that a current will flow.
Simply specifying a 6v solar panel is quiet useless. The solar panel needs to produce more than 9v to charge a 4v battery, using this circuit!!!!
The second problem with the circuit is this: The LEDs are connected directly across the 4v battery. White LEDs have a characteristic voltage of 3.2v to 3.6v. They will BLOW UP when connected to 4v !!!!

You will lean MORE through these discussions than any text book.
How do you think I became so clever? I fixed thousands of faults in electronic products and found out how NOT TO DESIGN A CIRCUIT. I found out thousands of things that NO TEXT BOOK ever explained.

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SPOT THE MISTAKES!

Page 25

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Some readers have asked why I don't include any formulas in the articles.
It's simple.
I would lose 99% of the readers.
I am not trying to make you a University scholar.
You can find all the mathematical approaches to electronics on the web and in every text book.
It's pointless doubling-up on what's already there.
But the funny thing is this: many of those providing answers to simple problems on the electronics forums can answer the mathematical questions but stumble terribly when trying to provide a circuit to perform a simple task.
They over-design, use an op-amp when a simple transistor will work perfectly and use component-values that are not in the normal range.
You can see instantly they have never deigned a circuit in their life, and relied on application notes to get them through.
That's why there are so few text books with practical applications.
As soon as they include a circuit that has not been tested, you can see their inability to "see" a circuit working.
This is the basis to what we are teaching at Talking Electronics.
The skill to be able to SEE a circuit working and thus fix, mend, design and modify circuits.
I know this is a skill, but it is the answer to being able to design.
It comes well-ahead of being able to carry out the mathematics as you are in-effect carrying out the mathematics "in your head" by assessing the current and voltage at each point in a circuit by looking at the resistor and capacitor values.
That's why this section on Spot The Mistake is so important.
It shows you how to spot a Mistake and see how and why others have made mistakes in their design.
It is an area that no-one has thought-of before.

We started this concept 30years ago when we included a section IF IT DOESN'T WORK, in all the projects.
Every project in a magazine expects the project will work.
But what if it doesn't work??
The only time you start to learn electronic is when you have to fix something.
And that's where most authors fall down.
They don't have the engineering skills to work through a project, using some part of the project as a piece of "test equipment."
It might be a LED or a speaker, giving a sound or flashing.
Or you can use a multi-meter or logic probe to diagnose the problem.
But the important point is NOT TO GIVE UP.

The mobile phone and the internet has increased communication between people over 1,000%. Whereas a few landline calls and letters were the only communication, we now have instant messaging where you can contact any one and any business anywhere throughout the world, in a matter of seconds.
The only problem is the sorting through the spam to get the actual requests from readers.
Sometimes, the bulk elimination of junk emails deletes a genuine request, but that's the price you have to pay for progress.
There are a lot more Chinese kits coming on the market at prices below the cost of components and these kits are very good value.
The only problem is the instructions.
Many do not come with instructions, especially set-up details and this is holding-back their sales.
Most of the kits work very well, although some could be improved.
It's only through the universality of electronics that it has exploded throughout the world. Imagine if we had 4 different resistor colour codes or 5 different component spacings.
We would be like the car industry, where nothing fits, from one model to another or one make to another.
Electronics would be as expensive as a BMW.
And if component symbols were a jumble, we would never be able to produce these Spot The Mistakes pages.

STATISTICS

Scientists (including electronics engineers) tend to disregard statistics as a "voo doo hypothetical imaginary invention" to con the unsuspecting.
Statistics is the generation of figures and numbers from one source and looking at the trend to apply the same reasoning to another identical or similar situation.

Take for instance, the number of readers who look at Talking Electronics transistor articles each day. Out of the 100,000 different readers who have visited the website, we get exactly 276 readers who look at the transistor article each day.
And the same applies to the 55 article. The rise and fall is very small.
Now we take EVERYDAY PRACTICAL ELECTRONICS with their TEACHIN-2015 set of articles. They say the series has been very successful.
But when you go to their website and look at the Forum, you will not find one enquiry about the series in the past 6 months.
In previous years the Forum has received several hundred enquiries.
What has happened?
Electronics has died.
The percentage of enthusiasm and construction has fallen from an initial 100% (1940 to 1980) to less than 10%, maybe 5%, maybe 2%.
Other things have taken over. Apps, games, 3D TV, Face book, have reached astronomical proportions where people are glued to their seat for 10 hours a day interacting on trivial matters with others in their group.
The decline in the interest in science has reached such a low point that some governments are now starting to tackle the problem by allocating new funding to this area.
I don't know whether this is necessary as great inventions and improvements will always come from the most unsuspecting quarters, however it is important to remind everyone that science is one of the most important studies in the education of man.
It was in the fore, 50 years ago with every school being provided with 2 new science classrooms and now it has hit the headlines with the theme of teaching "coding."

I got an email today from an Indian person who is obviously a Cybersquatter.

Cybersquatting. Cybersquatting (also known as domain squatting), according to the United States federal law known as the Anticybersquatting Consumer Protection Act, is registering, trafficking in, or using an Internet domain name with bad faith intent to profit from the sale of the website.

He has bought the name for less than $10.00 from GoDaddy in the hope that some idiot will buy it from him for an inflated price.

Here is his email:

Hi,

We are selling domain name ***MyMetalDetector.com***, Would you be interested in acquiring this Domain Name?
Please Advise
Kind Regards,
Chandan Mishra

I asked him how much he wanted.

Thanks for reply
We are just looking $400 for it

I told him I would pay $14.

He said that was too low.

Then he replied with the auction from GoGaddy where NO BIDS had been recorded and his reserve price was $20.00
Here is the link to the "auction:"
https://in.auctions.godaddy.com/trpItemListing.aspx?&miid=167759182

What a cheek he had. Trying to get $400 for a website that anyone could buy for $1.99 plus a few costs.
Cyber squatting is considered a crime in the US when a person simply buys a domain with the intention of preventing another "genuine" person gaining the domain name, and then trying to sell it for an inflated price.
This is clearly what Chandan Mishra chandan@dnavenue.com is doing.

Fortunately he has had no offers and will be stuck with the name until it dies.
Long gone are the days when websites had any value.
Visitors look on Google for a website and don't type in a URL because the slightest mistake will go to the wrong domain.
He has asked for this EXPOSURE to be deleted. This I will not do as he is clearly a FRAUDSTER.
Even selling the website for $20.00 contravenes the act. The act only states the fraudulent INTENTION is punishable. And the act is CYBER SQUATTING.
It's a pity he does not reside in the US.

I got a response from T.K.Hareendran, who has produced a number of faulty circuits in EFY and other magazines. He has a very limited understanding of electronics as explained on a previous page. After me exposing his lack of understanding of electronics, he got pretty annoyed and sent me this email:

After reading many of your web gimmicks, we - a group of young Indian circuit designers - plan to launch a website against your talking electronics.

This will be wonderful to see. Out of the 22 million visitors, no-one has shown me any of my "web gimmicks" unless he is talking about the tricky circuits and projects I have

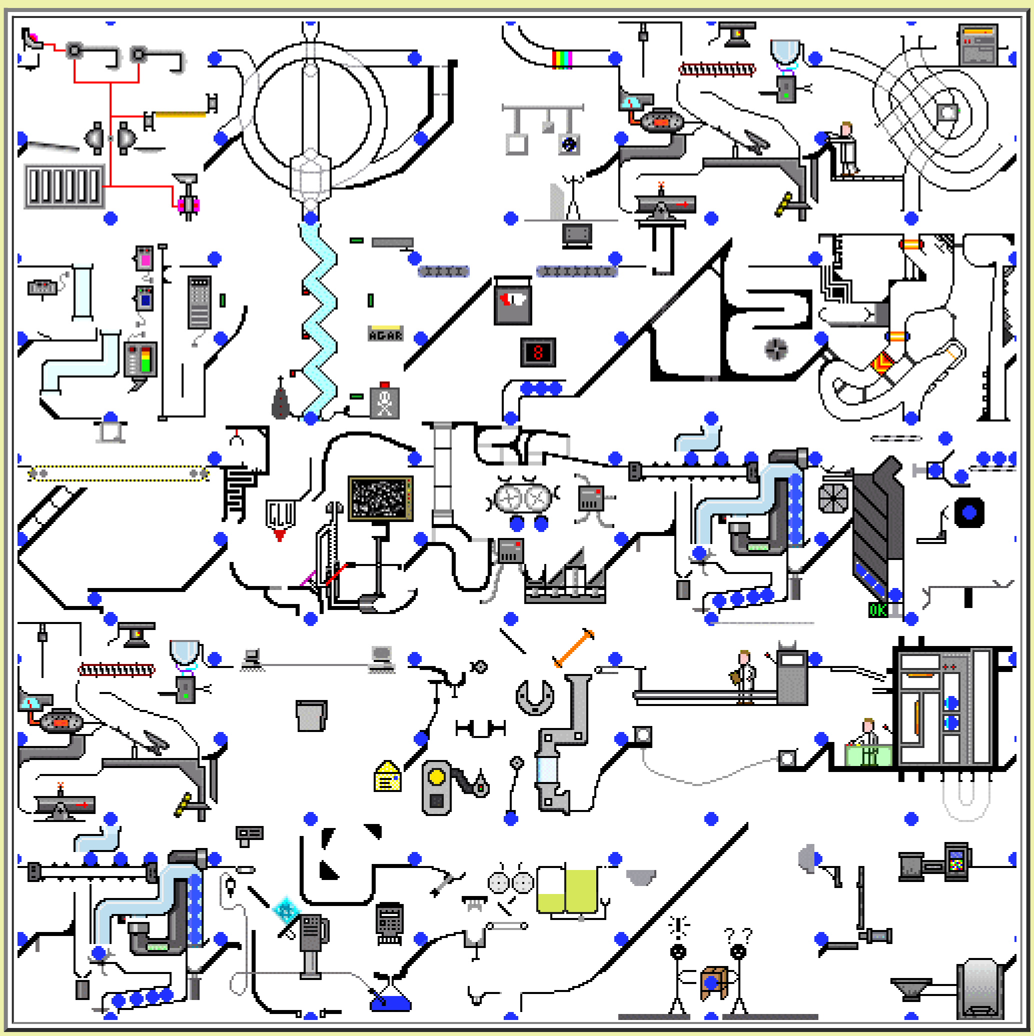
produced.
Along the same lines, one of the editors of Electronics For You, has replied to my statement that many of the circuits in the their magazine DO NOT WORK or have very poor design-features.
He comes up with stupid statements such as "All the circuits have been tested" and tried to get away with some garbled idea that the circuits are presented for experimenters to "tinker with" and improve.
I have never heard such nonsense and if this were said in any Australian magazine, the editor would be hounded off the "reading-list."
The simple fact is this: Indians have a very poor understanding of electronics and you can see this in their projects and writings.
Projects are presented as the "author's prototype" on breadboard or matrix board, with wires and leads going everywhere. It's just a jumble.
Many of the projects don't have a printed circuit board or the availability of a kit of components.
Kits and Spares is the only supplier of some of the kits and they want $50.00 postage for a $5.00 kit !!!
There has NEVER been an electronics instructional article in EFY magazine and the details of the operation of most circuits is very minimal.
In some cases they devote less than 6 pages of the whole magazine, to construction.
It is glaringly obvious that they are struggling to present technical information and the Indian hobbyist is suffering enormously.
They have never challenged any of the comments I have made nor provided me with the email address of any of the authors of the projects, so I can correct their work.
The editors of the magazine have never heard of "DESIGN CONCEPTS" where the value of a component is determined by the job it is intended to do.
Putting 0.22u on a 100MHz line or 10 ohm in a 300mA line shows a complete lack of electronics understanding.
This is the sort of thing we are exposing in these pages and "SPOT THE MISTAKES" allows us to cover all those things that don't fit into any of the other pages.
That's why we have reached page 25 !!

The only way to avoid debt is save money from the first day you start work.
And the second way is to have a trade or qualification.
It doesn't matter if it is electrical, electronic, mechanical or building, welding, painting or brick-laying.
Build up a skill in 1, 2 or 3 fields and you will have an inside/outside job and business/career for the rest of your life.
It's only those who waste their life from 14 to 18 that suffer the rest of their time with patchy employment.
Of course it would be wonderful to be a lawyer, doctor, dentist, investment consultant,

physiatrist or politician, but those lucky breaks are only available to very few.
The rest of us have to get educated the hard way and make a success of life in these extremely hard times.
Business, work and opportunities are actually 5 times more difficult to achieve than 30 years ago.
You have to be 3 times smarter than the previous generation to get ahead.
The reason is the conglomerates have taken over nearly all the lucrative areas of business including discount selling and enormous construction ventures,
Even the areas for promoting electronics are miniscule compared to 30 years ago.
That's why you have to be so clever.

If electronic circuits could be explained like this:

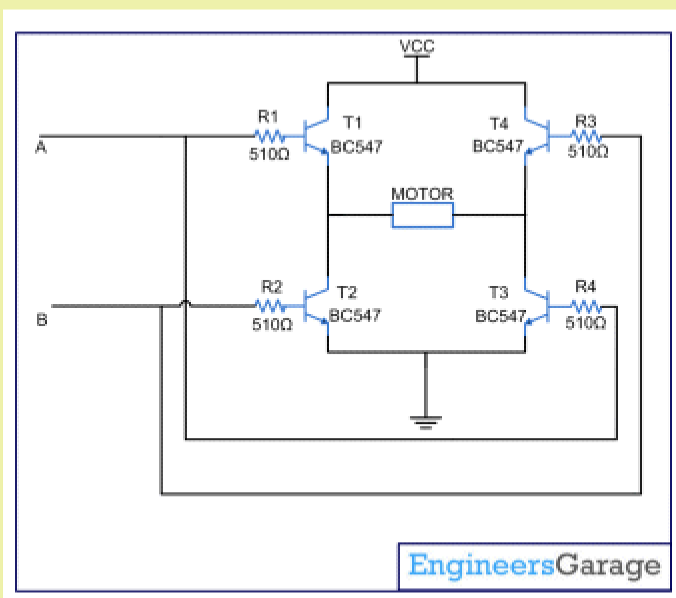
Everyone would be able to understand them.



Pearls of Wisdom

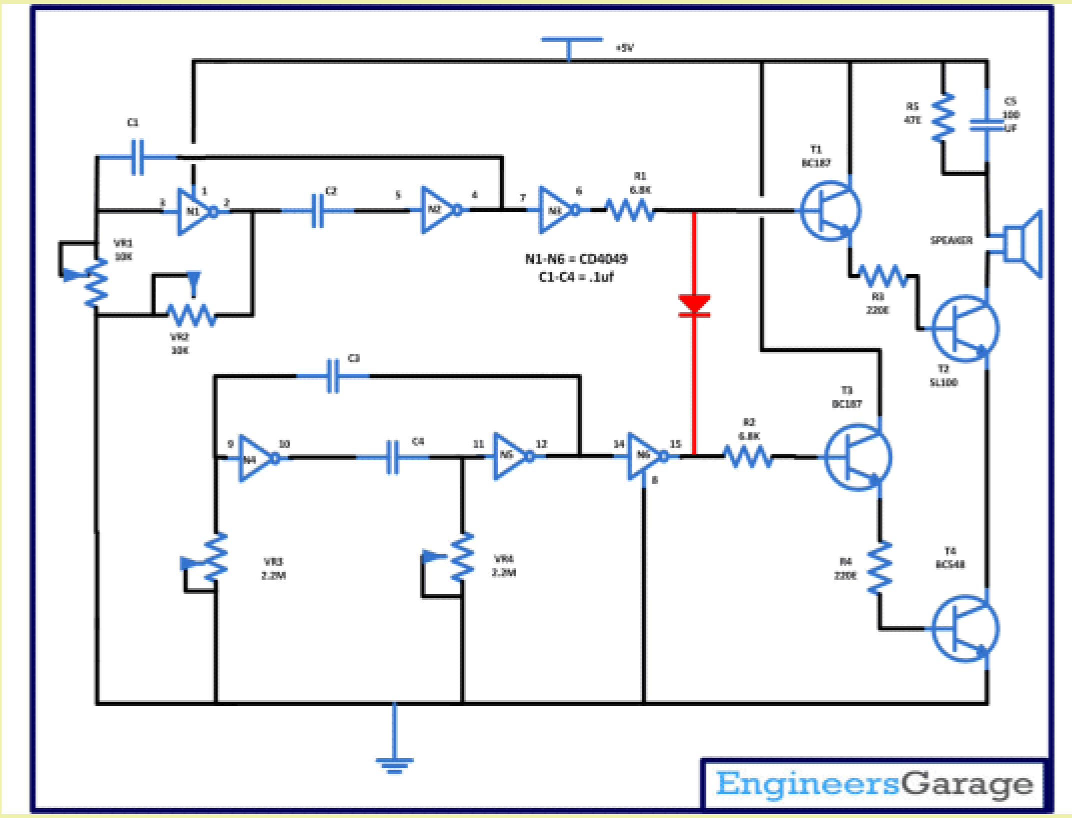
1. 42.7 percent of all statistics are made up on the spot.
2. 99 percent of lawyers give the rest a bad name.
3. Remember, half the people you know are below average.
4. He who laughs last, thinks slowest.
5. The early bird may get the worm, but the second mouse gets the cheese in the trap.
6. Support bacteria. They're the only culture some people have.
7. A clear conscience is usually the sign of a bad memory.
8. Change is inevitable, except from vending machines.
9. How many of you believe in psycho-kinesis? Raise my hand.
10. When everything is coming your way, you're in the wrong lane.
11. Hard work pays off in the future. Laziness pays off now.
12. On the other hand, you have different fingers.
13. What happens if you get scared half to death, twice?
14. Why do psychics have to ask you for your name?
15. Inside every older person is a younger person wondering, "What the heck happened?"
16. Light travels faster than sound. That's why some people appear bright until you hear them speak.
17. Life isn't like a box of chocolates. It's more like a jar of jalapenos. What you do today, might burn you tomorrow.

BRIDGE



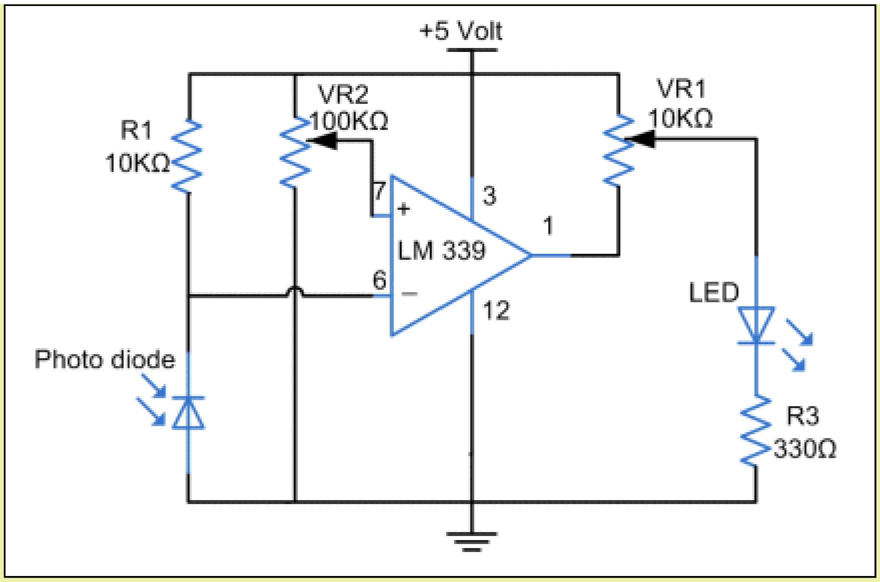
This bridge might work or it may not.
There are two things you have to remember when designing a bridge.
A motor takes 10 times more current when starting, than when it is at full RPM and the current can increase 5 -10 times when the motor is under load.

The transistors in the bridge have to deliver this current and a BC547 is only capable of delivering 100mA under the best conditions.
It is difficult to know how much current each transistor is capable of delivering in the bridge circuit above, however the top two transistors are EMITTER FOLLOWERS and the 510ohm resistor in the base is effectively reduced by 100 by the gain of the transistor to become equivalent to 5 ohms.
The resistance (impedance) of a motor is about 5 ohms and this will reduce the current. The transistor in this circuit will have the biggest effect on reducing the current-flow to a maximum of about 100mA.



This circuit can be simplified by removing the two lower transistors and adding the red signal diode.
The two lower transistors are simply turning the output ON and OFF and this can be done with the red diode.
This diode is called a GATING DIODE and prevents the output transistors delivering a signal to the speaker when the cathode of the diode is taken to 0v. The two lower transistors and two resistors are removed.
This is the accepted way to gate the output. It is called "**AND**" gating.

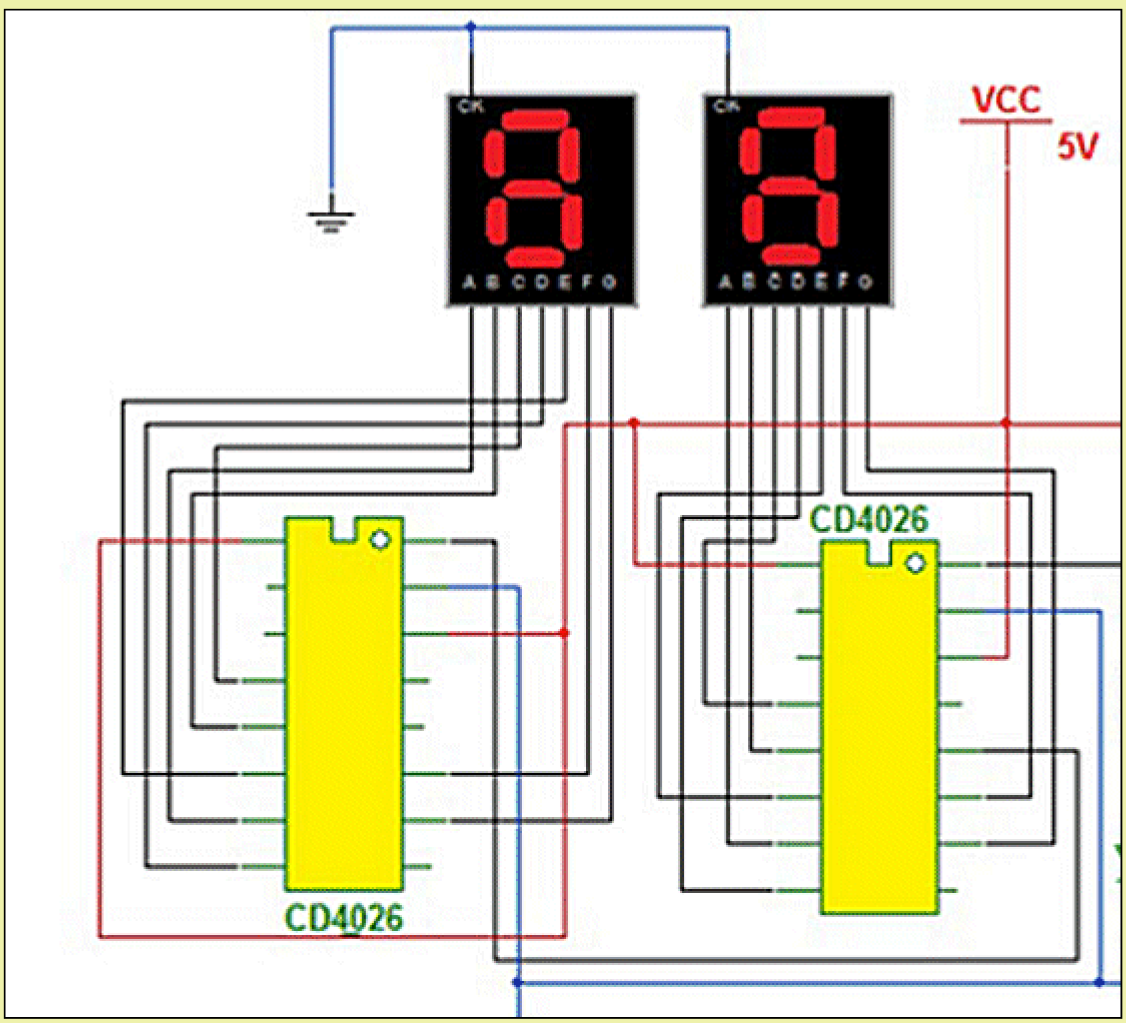
OP AMP

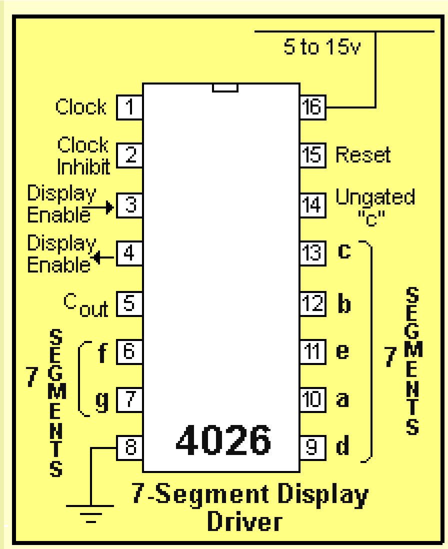


Can you see purpose of the 10k pot?
If you turn the pot towards the 5v rail, the LED will illuminate. A small rotation of the pot will reduce the brightness considerably. So we will turn it to the other end.
When the pot is fully turned to the output of the Op-amp, the circuit will work, but the slightest rotation of the pot will reduce the brightness considerably.
What is the purpose of the 10k pot?

---

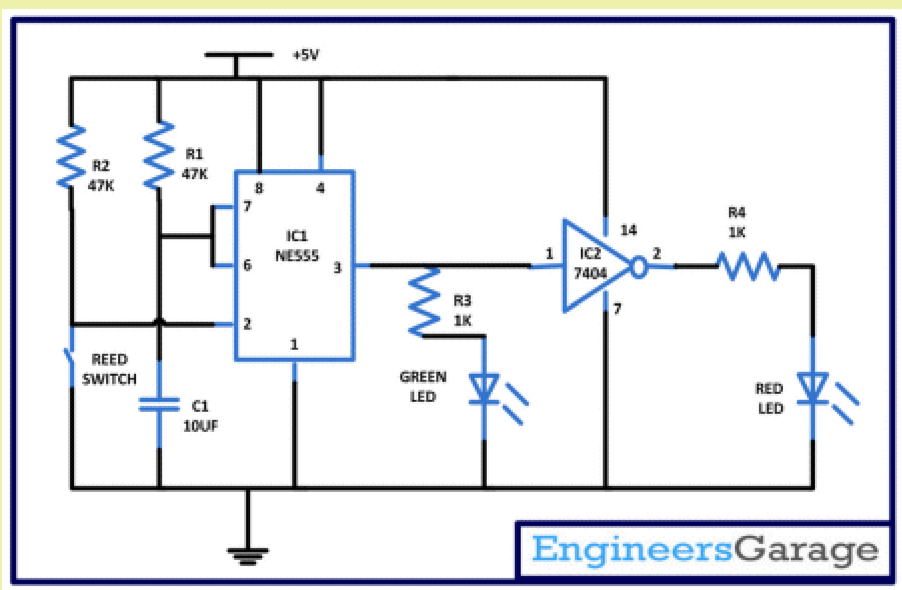
2 DIGIT COUNTER



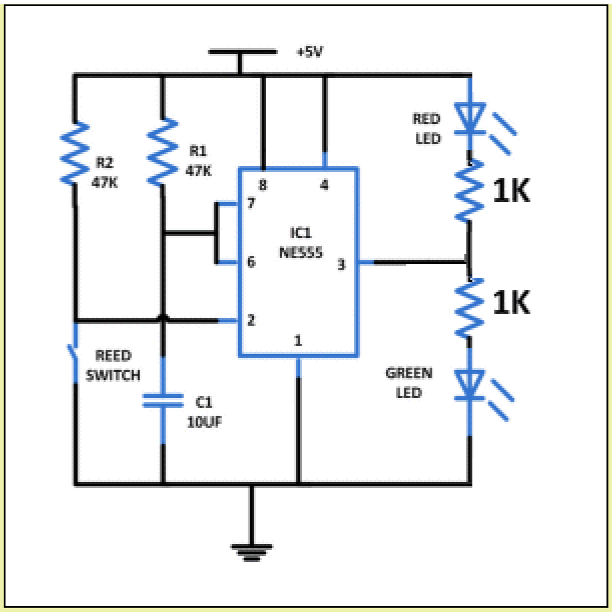


Here's something new!!! It appears the block diagram of the CD4026 is back-to-front in the circuit diagram above. You are looking at the underside of the chip!!!
This is NOT how to represent a chip.
All chips are looked-at from the top and pin 1 is always on the left of the diagram.
If you don't have a standard way to represent things in electronics, it gets very confusing.
You will also notice pin 8 of the chip is not connected. The chip will not work with pin 8 not connected to 0v rail.

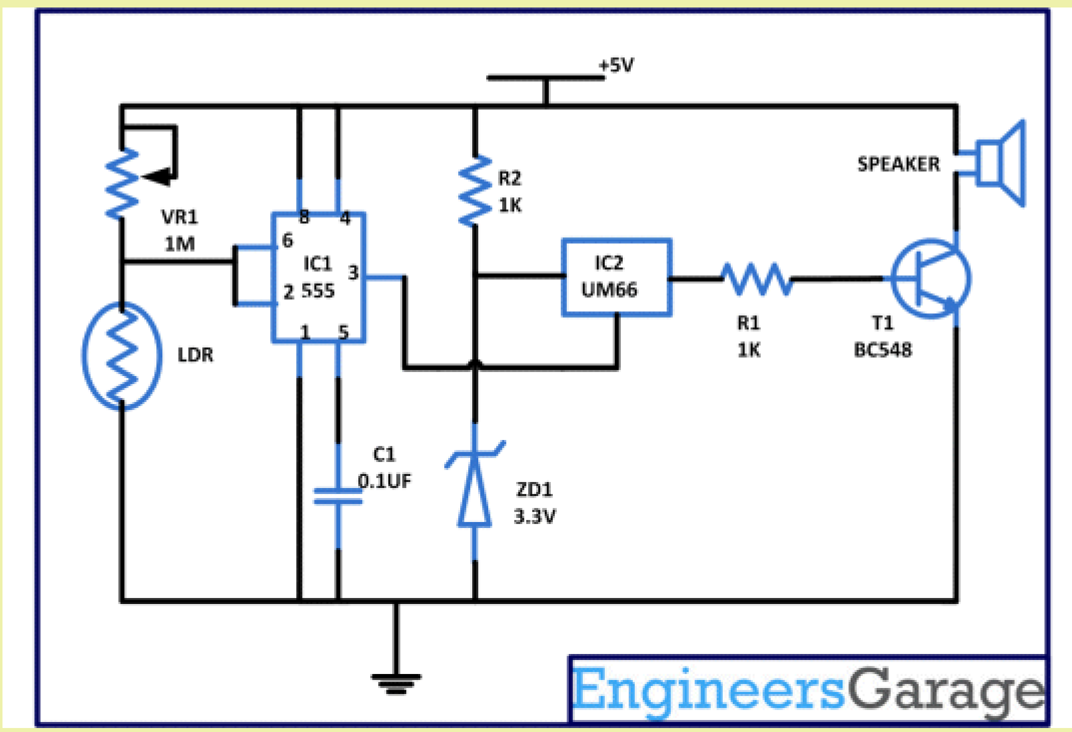
CROSSING LIGHTS



The circuit above can be simplified:

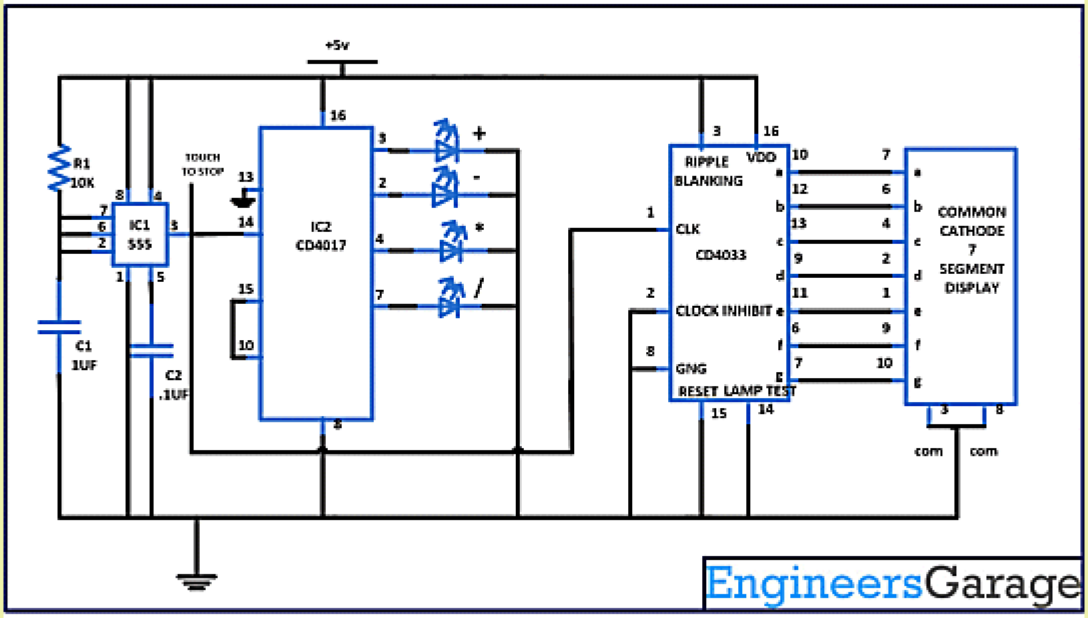


MAGIC EYE



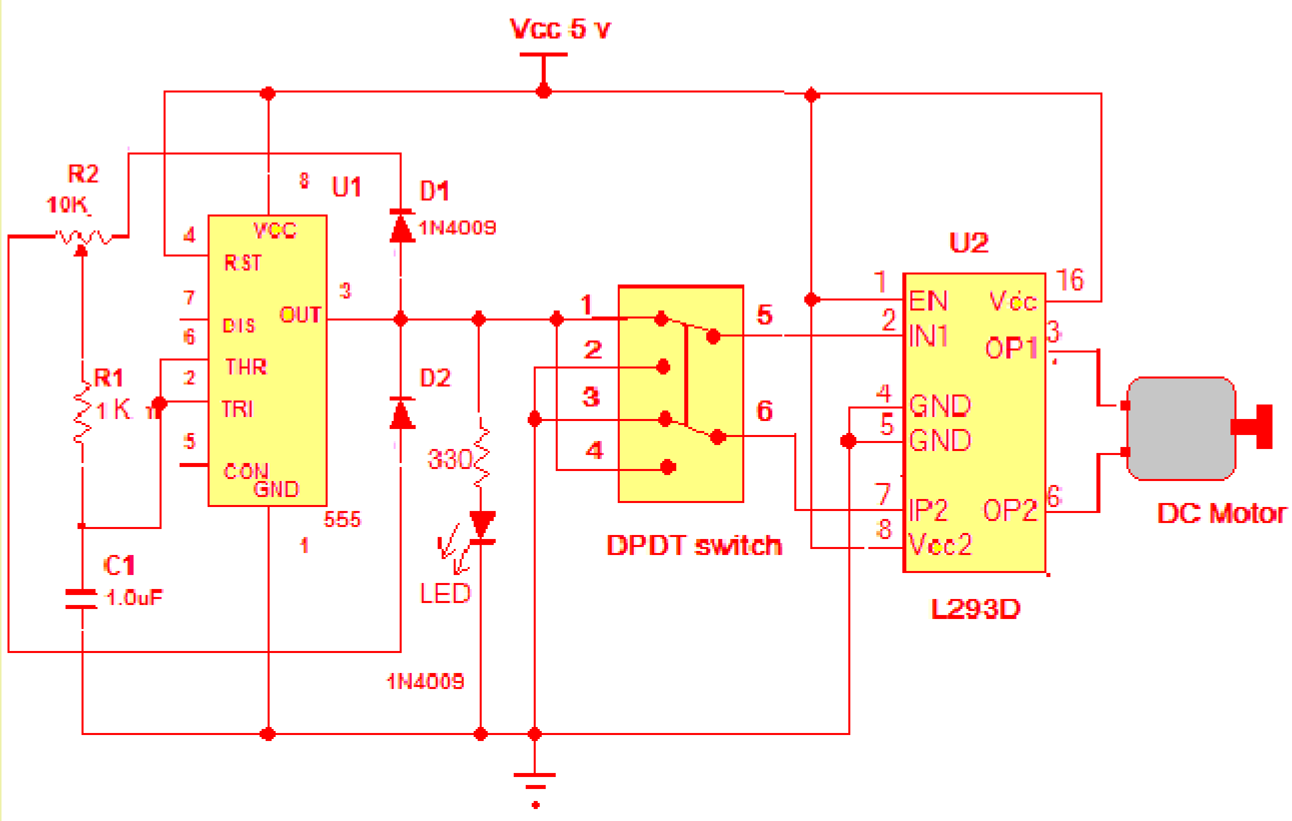
Two faults with this circuit.
1. The 1k supply resistor and 1k resistor to the base of the transistor will form a voltage divider that will only deliver 2.5v to the chip.
2. When pin 3 of the 555 goes HIGH, the UM66 music chip will see a reverse voltage as the "earth pin" will see 5v and the supply pin will see about 2.5v. This may produce a high current through the chip. I have not tried connecting the chip around the wrong way !!!

NUMBERS GAME



Three faults with this circuit.
1. I do not know how the TOUCH STOP works.   The output of pin 3 of the 555 is a low impedance pin so touching the wire will have no effect.
2. No current limiting resistor for the LEDs on the CD4017. This resistor is not essential as the chip can only deliver about 10mA from an output line, but adding the resistor puts less strain on the FETs inside the chip.
3. No current-limiting resistors between the CD4033 and the 7-segment display. Without the resistors, the LEDs will be extra bright and the additional current may put a strain on the CD4033 IC.
The circuit is designed by an incompetent hobbyist and should be removed from the web.

MOTOR CONTROLLER



Look at the circuit carefully and you will see the L293D chip is not needed. The 555 is capable of delivering 200mA and if the motor needs up to 200mA, it can be connected to the DPDT switch and the L293D removed. The L293D loses 1v when the output is HIGH and 1v on the LOW output. This means the maximum output voltage will be 3v.
If the DPDT switch is placed after the L293D IC, the voltage will be 4v.

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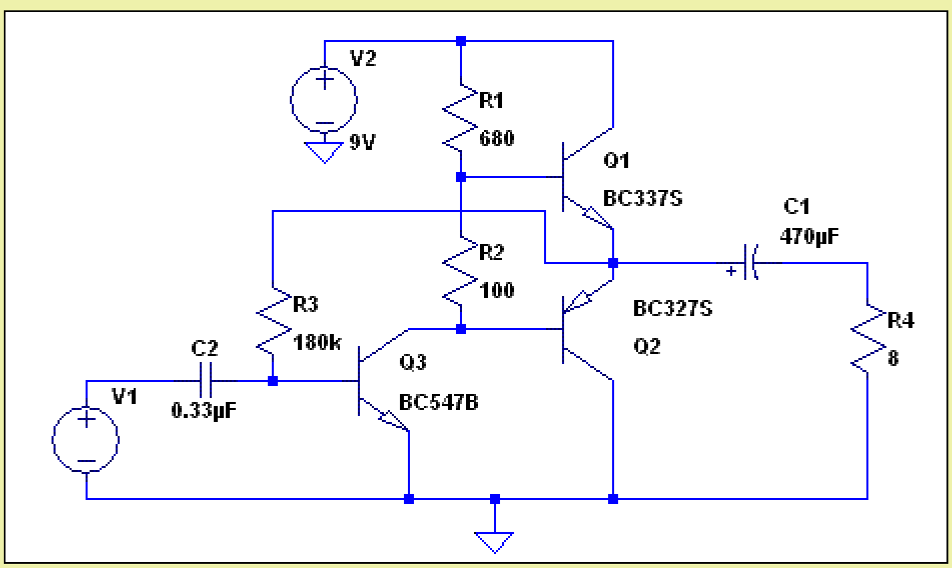
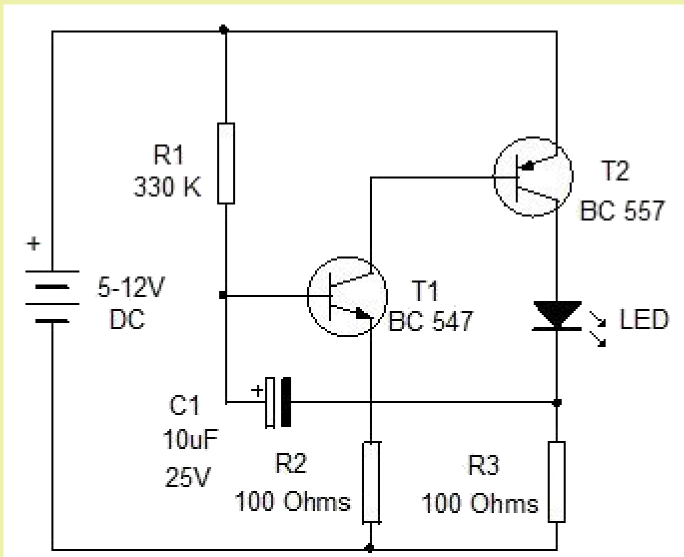
3 TRANSISTOR AMPLIFIER



This circuit was found on an electronics forum where the person wanted to reduce the distortion.
There were a lot of replies including changing the 100R for diodes and adding resistors to reduce the gain.
But NO-ONE outlined the real reason for the distortion.
The reason for the distortion is the fact that the output transistors are connected in an arrangement called PUSH PULL.
When the first transistor is not turned on, the BC337 transistor is pulled HIGH by the 680R resistor. This action pulls the 470u electrolytic HIGH and and current flows through the 8R load.

During this time the 470U electrolytic charges a small amount.
When the first transistor turns ON, it pulls the BC327 down with 100 times more strength (current) than the current flowing through the collector-emitter terminals of the BC547.
The BC547 is equal to about 47R resistor.
This means the "pulling down" is equal to 47R and the "pulling up" is 680R.
Since these are very different values, the current in the 8R load is limited to the weakest part of the cycle - the 680R and this has the greatest effect on producing a faulty output.
Even though one part of the cycle is 15 times more powerful than the other, the electrolytic can only charge (or rise) to the amount offered by the 680R portion of the cycle and the strong part of the cycle simply discharges the electrolytic.
But it can discharge it much faster than the charging part of the cycle and this contributes to the distortion.

LED FLASHER by D Mohankumar



LED FLASHER

The circuit works but the description is totally incorrect. The circuit is NOT a Relaxation Oscillator. **It is a FEEDBACK OSCILLATOR**

Here is his description:
The circuit is a simple Relaxation oscillator using two complementary transistors BC 547 and BC 557. Capacitor C1 is doing the trick and it gives the positive feedback to start the oscillation of T1 and T2.

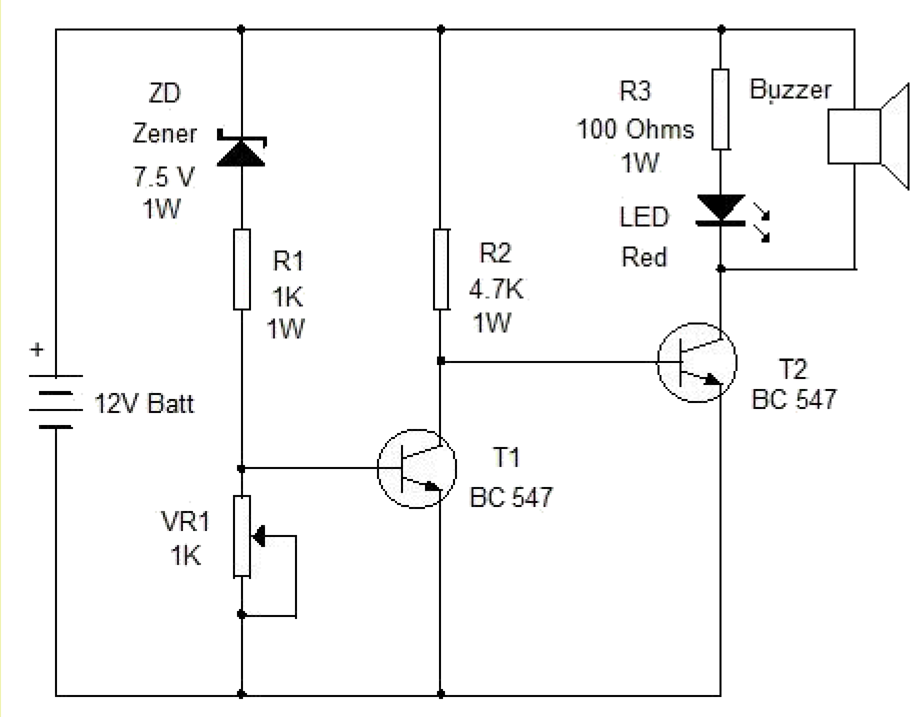
This is INCORRECT. R1 starts the circuit working.

R1 and C1 form the timing components of the oscillator and with a 330 K resistor (R1) and 10 uF capacitor (C1) the LED blinks around 1 Hz rate. **This is correct.**
When power is applied, C1 starts charging via R1. When C1 fully charges, **NO. C1 charges to 0.6v to starts to turn on the first transistor. T1 is an emitter-follower and it rises. C1 has to keep charging to keepT1 turned ON.**

T1 conducts and pulls the base of T2 to ground potential and it also conducts. The collector of T2 gives power to LED and it lights. At the same time C1 discharges through R3. **This is INCORRECT. The voltage on the top of R3 rises and this pushes all the charge in C1 into the base of T1 to keep it turned on. Eventually all the charge is removed and T1 starts to turn OFF.**

So T1 and T2 turn off. This turns off LED. Again C1 starts charging and the cycle repeats making the LED blink continuously.

BATTERY MONITOR by D Mohankumar



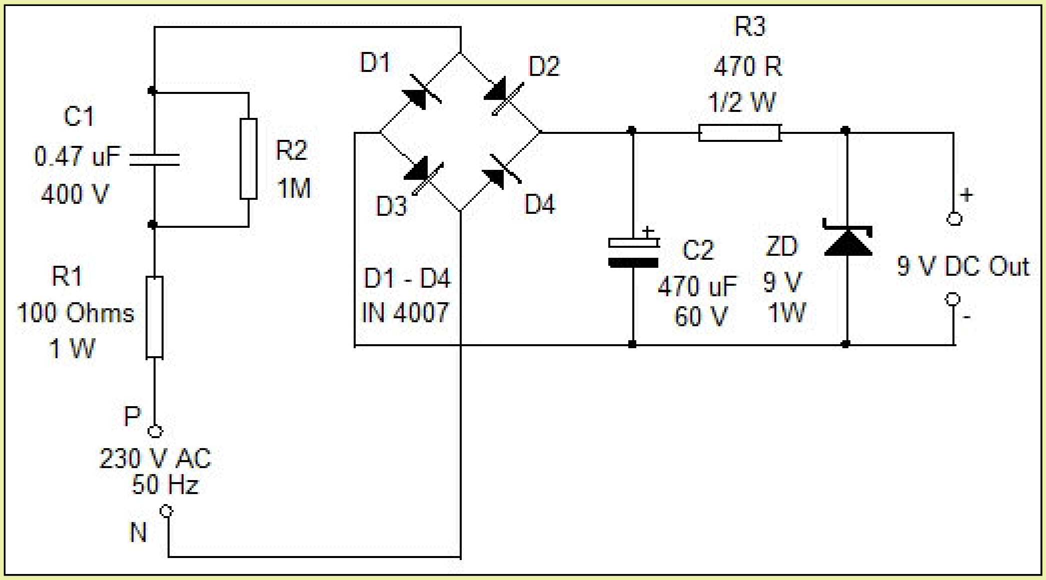
The circuit will activate when the battery goes below 8v. This is too low for the 12v battery.
The resistors can be 0.25 watt

Look at this faulty description:
Zener diode is a special kind of diode that conducts only when it gets a voltage more than its rated voltage. For example, a 7.5 Volt Zener diode used in the circuit requires more than 8.5 volts for its smooth conduction. That means, the Zener requires + 1 or 1.5 volt excess than its rated value for proper conduction.

What RUBBISH !!
Why have a 7.5v zener diode if it works at 8.5v ???
A zener diode produces a voltage across it VERY CLOSE to its printed value. That's why you can create an accurate 12v supply when using a 12v zener diode.

What Indian school of electronics did Professor Mohankumar teach at ?????

POWER SUPPLY by D Mohankumar



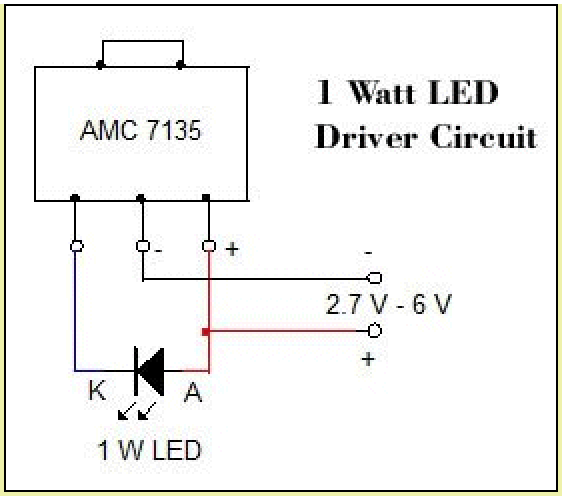
Every circuit by Mohankumar contains faults.
Look at this Power Supply circuit.
The purpose of any electrolytic in a power supply is to store energy and reduce the ripple. That's what the electrolytic in this circuit is doing.
To take advantage of its stored energy, you must connect directly across the electrolytic. The 470R resistor is NOT NEEDED. It turns this power supply into a USELESS POWER SUPPLY.
The current through the 9v zener is 35mA.
As soon as you put a load as little as 250 ohms on the output, the current through the LOAD will be 35mA and any further LOAD will start to reduce the output voltage.
If you put extra LOAD on the circuit, the current will not increase but the output voltage will reduce.
What happens is this: A 250R load in series with 470R produces a voltage of 9v at their join.
As soon as you reduce the 250R, the zener drops out of regulation and the voltage across the LOAD decreases.

In his article, he tests the output of the power supply WITHOUT A LOAD and comes up with stupid decisions about how much current will be available at the output.
Tell him to learn how to test a circuit. I am sick of emailing him. I have emailed him for the past 3 years. He never listens.

Mohankumar does not check or test any of his circuits CORRECTLY and he keeps putting his RUBBISH on the web. He has been told to test his circuits and all his Indian friends keep supporting him, saying how wonderful his circuits are. You decide.

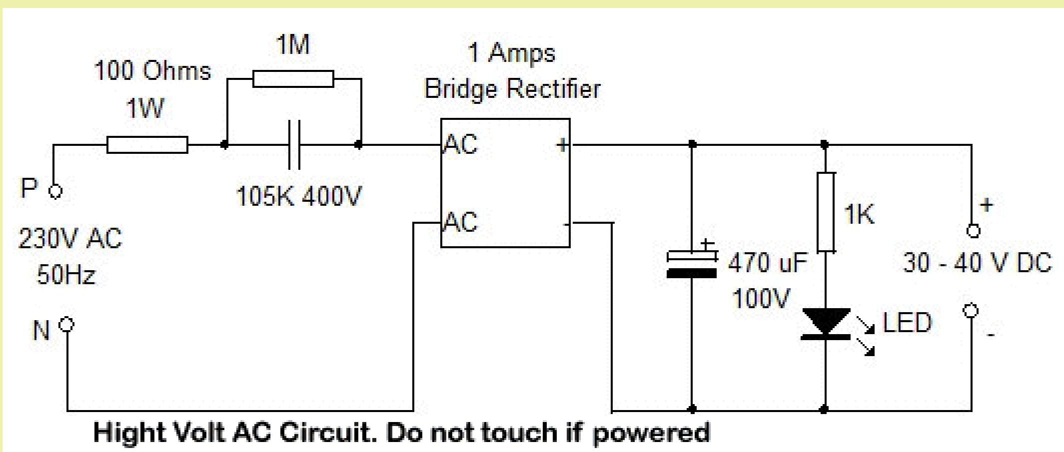
POWERING A LED by D Mohankumar

When will we get rid of this idiot Mohnakumar.
Here he is with more of his RUBBISH.
The image shows a white LED powered from 3v via an IC AMC 7135.
The AMC 7135 is a constant current chip capable of delivering a constant 350mA to a 1wattLED.
A 1 watt white LED has a characteristic voltage across it when the current is more than about 100mA of about 3.2v and this increases to about 3.6v when 350mA flows.
But when you reduce the current to less than 50mA, the characteristic voltage across the LED is about 3v.
This means you can directly supply the LED with 3v and about 20mA flows.
YOU DO NOT NEED THE AMC 7135 IC !!!!
The IC just makes the LED dimmer as it drops about 120mV !!!
This circuit that the idiot Mohnakumar has produced is absolute RUBBISH !!!!
I don't know how he can get everything SO WRONG !!!!



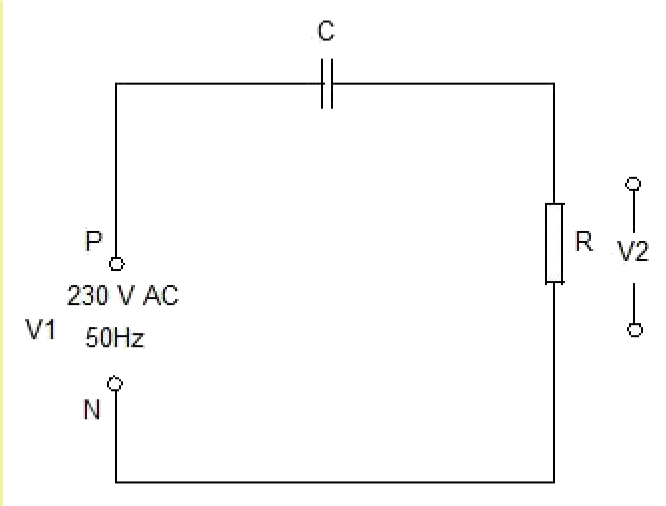
Just because the IC will work down to 2.7v, Mohnakumar thinks you can drive a 1 watt LED from 2.7v. But most 1 watt LEDs are white and they have a characteristic voltage across them of 3.6v.
When will he learn ????

CAPACITOR-FED POWER SUPPLY by D Mohankumar



Here is a capacitor-fed power supply by D Mohankumar.
In his article he tries to explain how a capacitor passes a certain current according to its value.
But he still has no idea how the circuit works. Look at the circuit above.
He correctly states the current delivered by a 105 (1u) capacitor will be 60mA to 70mA, BUT he also states the output voltage will be 30v to40v.
How does he come up with this value ????
The output voltage of a capacitor-fed power supply will be 340v DC (if nothing is connected to the output) and the LOAD determines the actual voltage.
The load is the LED and 1k resistor. If 70mA is available, ALL this current will flow through the 1k resistor and the voltage developed across it will be 70v !!!!!
The current through the LED will be 70mA and the **LED WILL BLOW UP**. !!!!!!
That's how little Professor Mohankumar knows about electronics !!!!
He is so dangerous he should not be on the web. It's IDIOTS like him that give the web a bad name.
He is totally uneducated and does not understand the simplest electrical engineering problem.

Here is more RUBBISH from him:



He says: ***When a capacitor (C) and a resistor (R) are connected to AC lines, a constant current can be maintained through the resistor (R) so long as the "Reactance" of the Capacitor is greater than the "resistance" of the Resistor.***

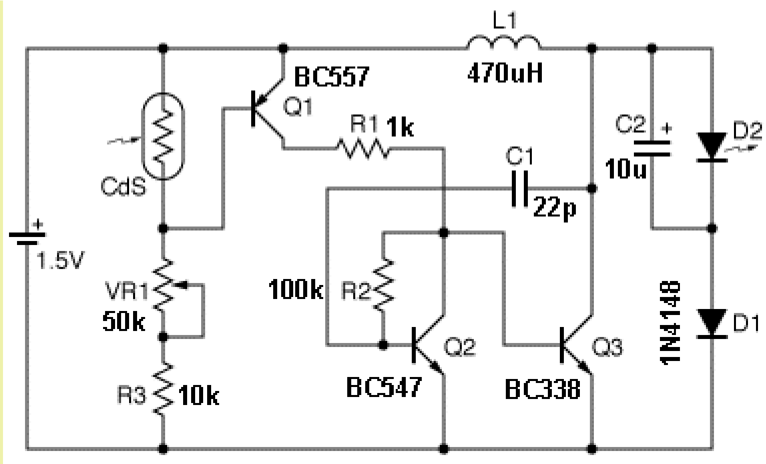
What RUBBISH.
Suppose the resistance of R is LOW and 60mA flows through it.
Suppose R is increased and 125v appears across it. The current will be 30mA.
If we go to the extreme and use a very high value for R, the voltage across R will be 230v and NO CURRENT WILL FLOW.
This is simple to understand. A high value LOAD is just like NO load AT ALL and the output voltage will rise.
If you have NO load, it means NO current will flow through the capacitor and thus NO voltage will be dropped across it. The capacitor is really like a 10k resistor for part of the cycle and if NO current flows through the 10k resistor, there will be NO voltage dropped across it and thus the output voltage will be as high as the input voltage.

Professor Mohankumar did not even bother to look at the logics of the circuit and came up with an absurd statement. This is why he should not be on the web !!! He is a FRAUD. A person with NO electronics ability masquerading as a professional. He doesn't even make corrections to his projects after he is informed of his mistakes. That's the CRIMINAL part. He KNOWS he is supplying faulty information.

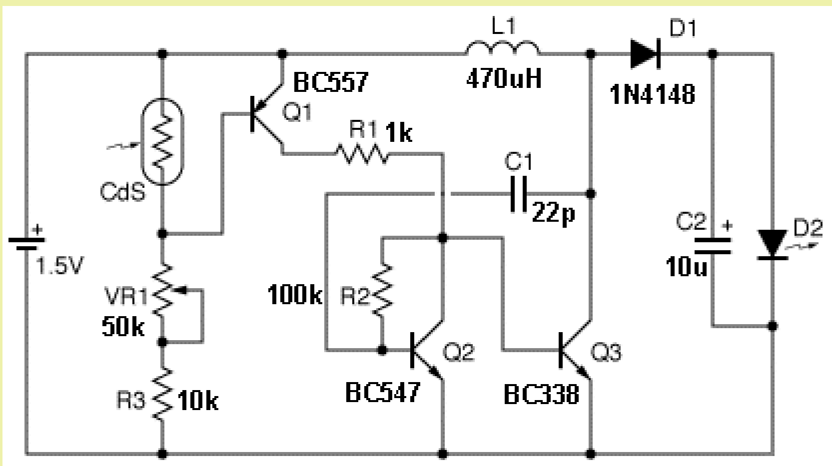
The fact is this: As the output voltage increases, the current capability of the circuit decreases, but since you have a large voltage available, this reduction in current is not really noticed.

Text books just give you examples of circuits that work. We give you examples of circuits THAT DON'T WORK.
You learn more from a FAULTY circuit than a circuit that works.
It was only after starting to fix faulty black and white TV sets that I realised by degree in electronics was almost worthless.
The attitude of the lecturer was this: ANYTHING YOU BUILD WILL WORK !!!! What a BIG mistake.

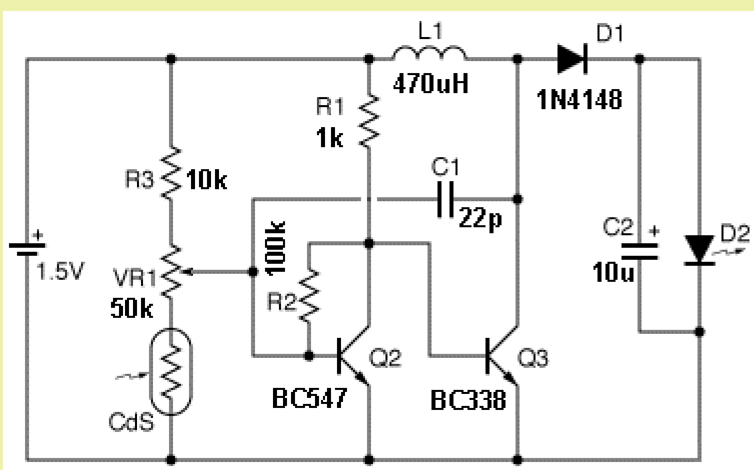
Here's a **Joule Thief** circuit using an inductor. The position of the 1N4148 looks to be rather unusual and I had to look at the circuit for 5 minutes before I realised it was preventing the 10u discharging via the inductor and so I re-positioned it to show exactly what it was doing.
That's why you have to draw a circuit using a placement and CONVENTION that everyone recognises.



Every component needs to be placed in a position on a circuit so its function is immediately recognised.
I can now see how the circuit works::

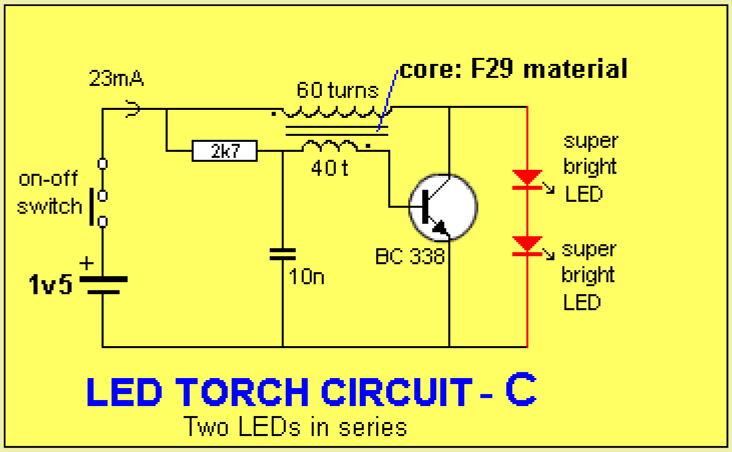


The next change to the circuit is the BC557. It is not needed. The photo-cell can be re-positioned and the transistor removed to create the following circuit:



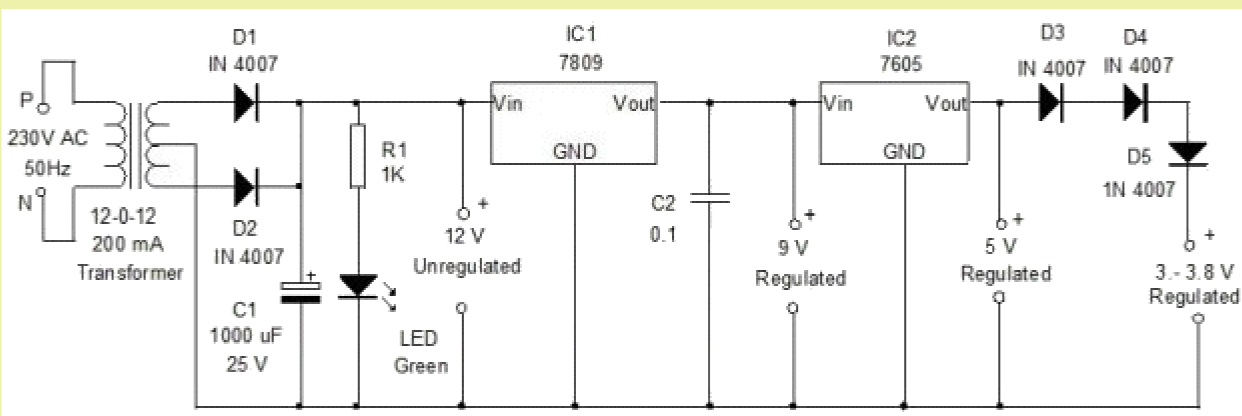
The circuit above is a really bad design..
It does not have what we call REGENERATION.
Regeneration is a feature of a circuit that uses positive feedback to improve the amplitude of the output. In the circuit above, the output transistor is turned on via the 1k resistor when the first transistor is turned off.
And when the first transistors is turned ON, the second transistor is turned OFF but the current through the 1k is wasted.
In the circuit below, the transistor gets turned ON a little via the 2k7 and then it gets turned ON more and more by the voltage produced in the 40 turn winding. The 10n is to stop the current generated by the feedback winding being lost in the 2k7. Thus the extra current fed into the base of the second transistor is only produced

during the time when it is needed.
When the circuit is turned OFF, the voltage in the 40 turn winding is produced in the **opposite direction** and no current flows into the 2k7, due to the capacitor, again. Thus this type of arrangement is much more efficient than using a 1k resistor and shorting the current from it to 0v rail, to divert it from the base of the output transistor. This is like shorting your incoming 230v mains to ground so you don't get any electricity when you don't want it !!!
It might seem insignificant, but when you understand these things, you can see how brilliant designers and engineers have created DC to DC power supplies with 90% efficiency and CFL's with 95% efficiency. When you go from 10mW to 10 watts to 100 watts to 10,000 watts, getting rid of unwanted heat is a big problem.
And the understanding all starts with a 10mW inverter..



This circuit produces a brighter illumination from TWO LEDs while using the same current as the previous circuit.

POWER SUPPLY by D Mohankumar



Only 2 faults with this circuit.
The 12v unregulated will be about 16v and the 3v to 3.8v will be 2.9v to 3.1v

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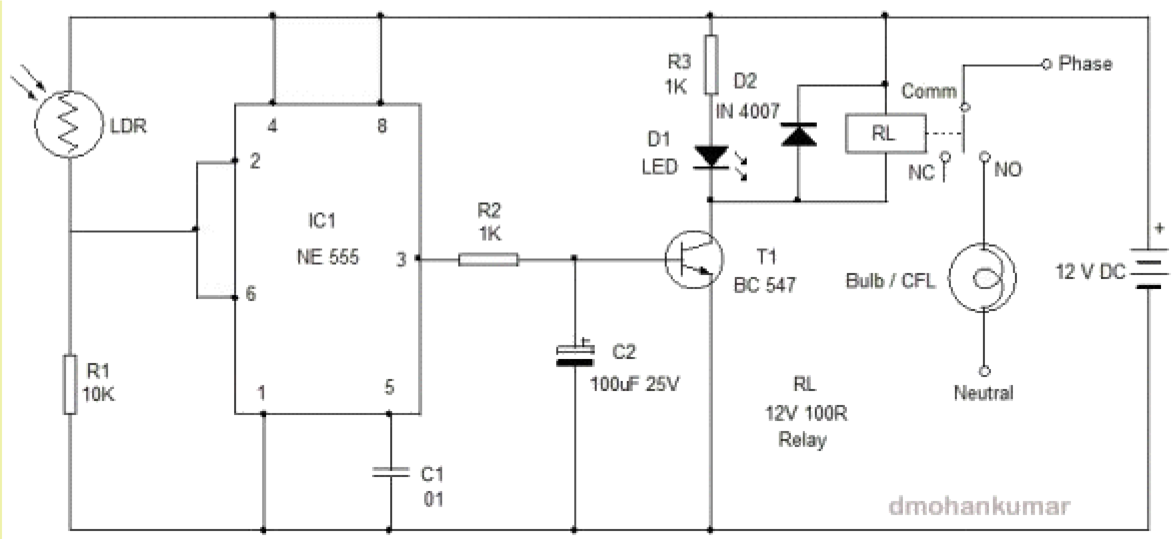
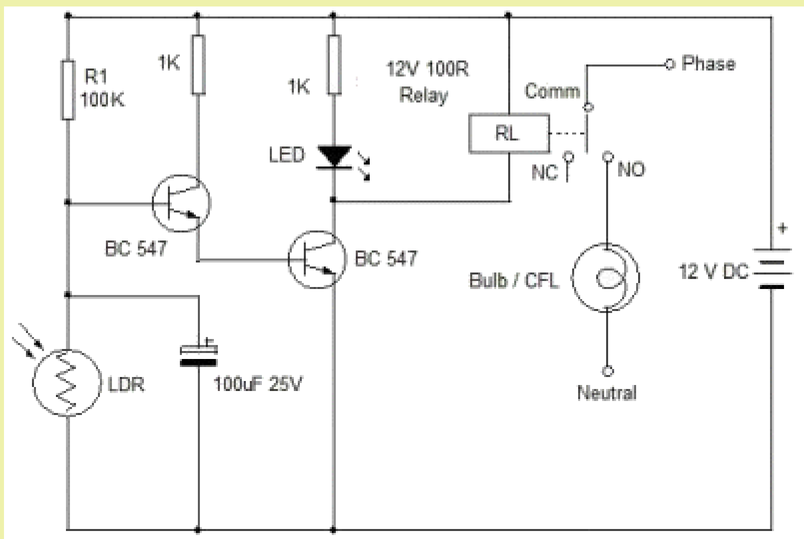
SUNSET LAMP by D Mohankumar



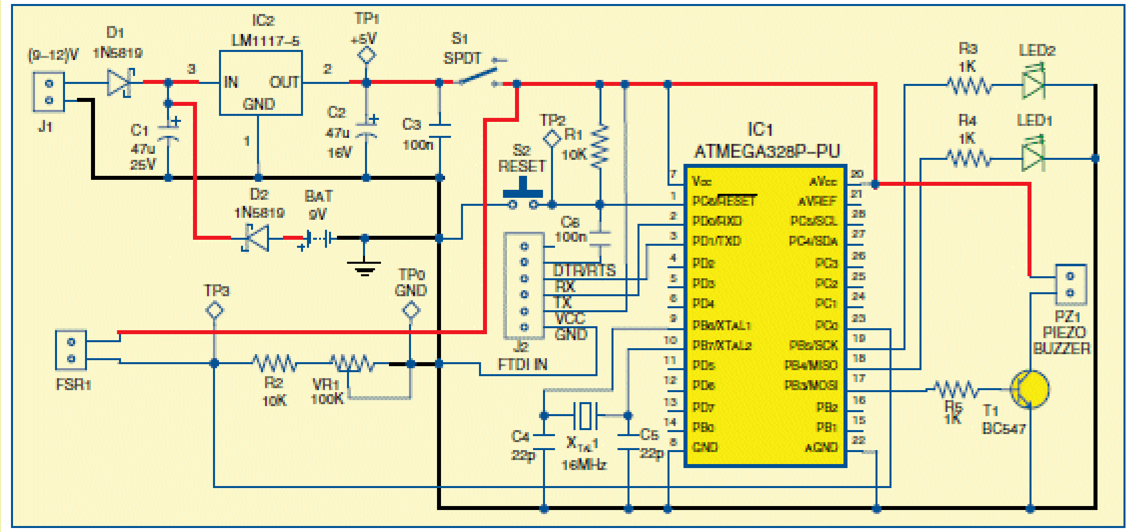
The circuit is over-designed. It just needs 2 transistors:



The first circuit takes 10mA via the 555 all the time. The second circuit takes less current.
The diode across the relay is not needed because the transistor switches at a very slow rate.
The 100u is in a bad position in the first circuit. It has a much bigger effect in the second circuit and can be replaced with 10u.
If Professor Mohankumar knew anything about circuit design, how would not make these mistakes.

BED ALARM

Here's another totally impractical project from **T.K.HAREENDRAN**
He has used a 28 pin microcontroller where an 8 pin chip will do the job.
He has used exotic diodes, whereas a simple 1N4004 will do the job and a regulator that you will have to buy from a large wholesaler.
He obviously gets his parts for FREE by claiming to be a "writer" and expects INDIAN hobbyists to buy all this expensive stuff to make a simple BED ALARM.
My father made the same thing 60 years ago with a vibration detector under my bed that makes contacts when I climbed out of the bed. He used a front-door bell that rang and vibrated when I made a lot of movement.
Firstly, there was no electronics 60 years ago, and a simple vibrating weight and bell is all you need for this project. Think outside the square or "think outside the box" and you will realise how stupid this project is.



BED ALARM

And he has used a Force Sense Resistor to detect when a child climbs out of a bad.
He says to place the resistor near the child's shoulder to detect the load abut if you have ever tried to detect a load in a bad you will find this is a very difficult thing to do. He has obviously never tested this circuit as a sensor like this is USELESS.
You need a large sensor made from two sheets of aluminium cooking foil and placed between the sheets is a think layer of black resistance foam as used when placing sensitive chips in foam. This will detect a much larger area.

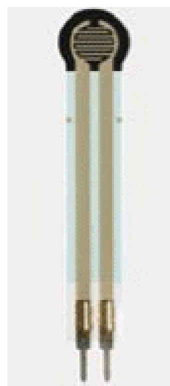


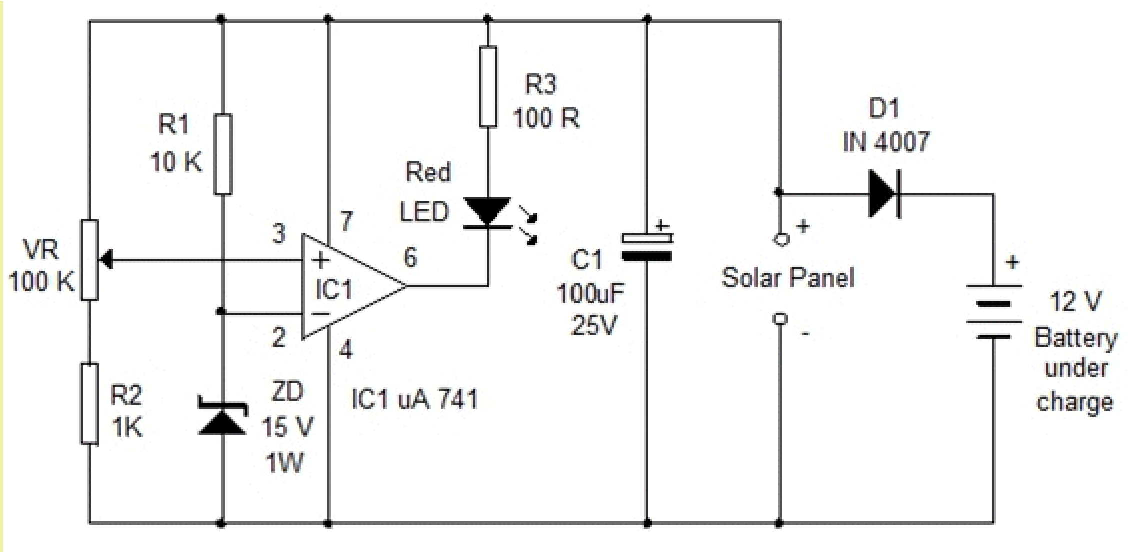
Fig. 1: A force sensing resistor

Conductive foam sheets

Electronics For You have now protected themselves by saying THIS PROJECT HAS NOT BEEN TESTED IN EFY LABORATORIES.

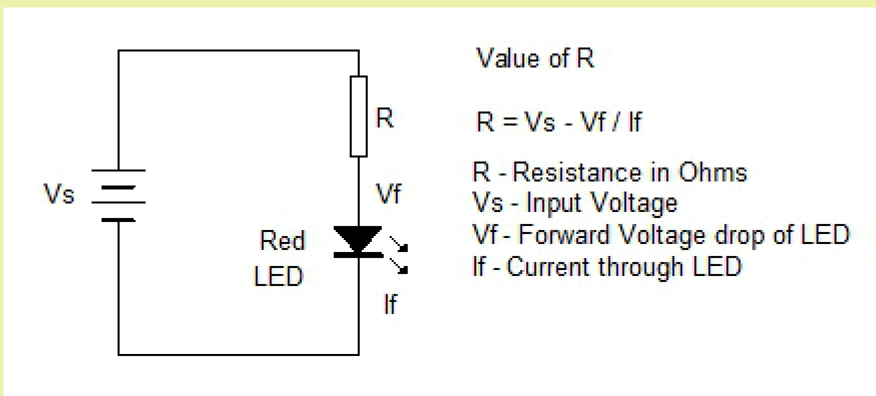
VOLTAGE MONITOR by D Mohankumar

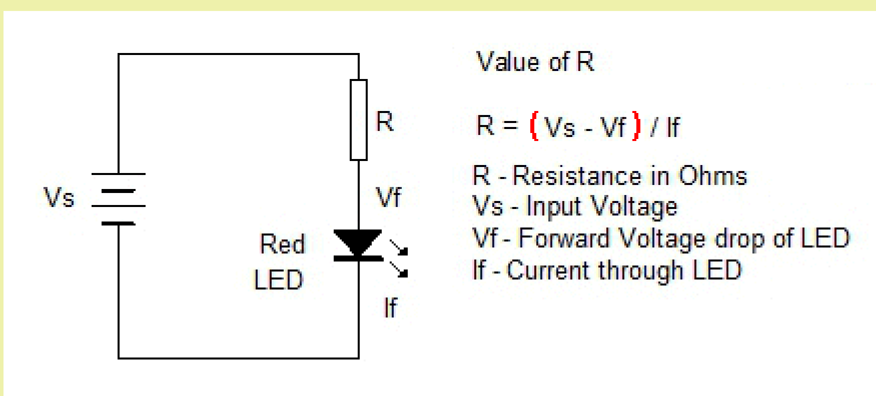
Here is another untested circuit from the same IDIOT:



The current through the LED will be more than 100mA. The IC can only output 25mA !!!
What does R2 do ???

Ohm's Law by D Mohankumar





Professor Mohankumar doesn't even understand basic mathematics.
He is the second Indian "Professor" to fail basic mathematics.
The terms Vs - Vf must be in brackets so that you work out the answer of (Vs - Vf) and place the answer in the bracket and then perform the division.

LED Current by D Mohankumar

Professor Mohankumar says: **Current through a LED must be between 10 to 25 Milli Ampere**.
This is NOT true. Some ultra bright red LEDs are "too bright" if more than 3mA flows.
LEDs are becoming more and more efficient and a current as small one to five mA will be sufficient.
You need to buy and test each LED before deciding on the current required.

Look at this rubbish:

The new type 0.5 and 1 watt White LED requires 100-350 mA current. Forward voltage drop is 3.6v. So the value of the resistor must be very low. Since high current flows through the resistor, the wattage of resistor must be ½ or 1 watt otherwise, the resistor will heat up and burn. Suppose the current required is 250 mA, then the resistor is

R = (Vs - Vf)/ If = (12 – 3.6) / 0.25 A = 8.4 / 0.25 A = 33.6 Ohms. Use 33 Ohms 1 watt resistor

He has not bothered to work out the wattage lost in the resistor !!

The wattage lost in the resistor is:
Power = (V x V) / 33
= (8.4 x 8.4) / 33
= 2.14 watts!!

or:

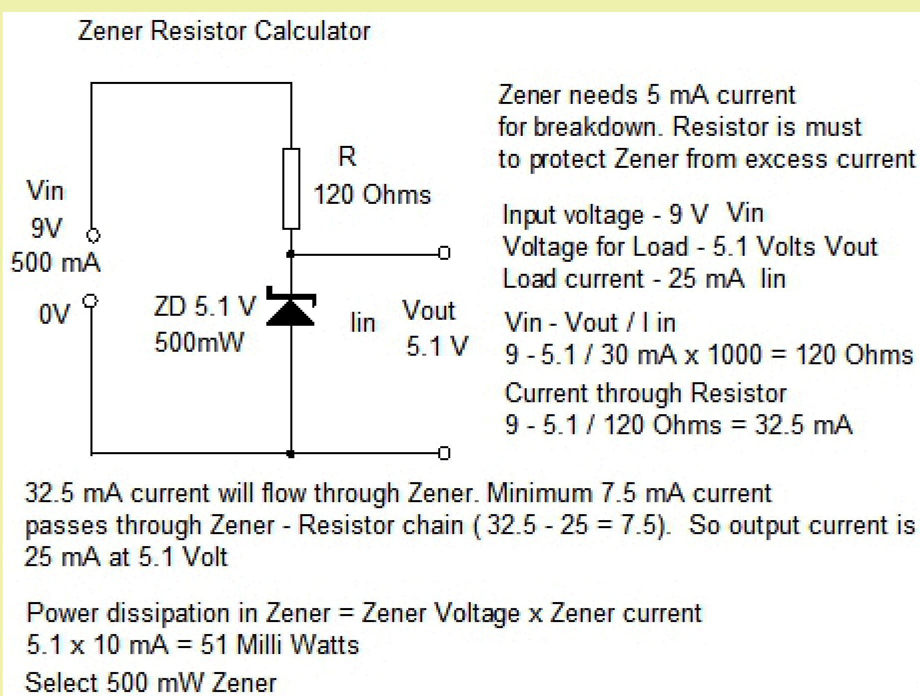
Power = V x I
= 8.4 x .25
= 2.1 watts !!

He has absolutely no idea what he is doing.

I could "see" the wattage lost in the resistor is more than one watt before starting to work out the actual value. That's why I questioned the answer. And I was right.

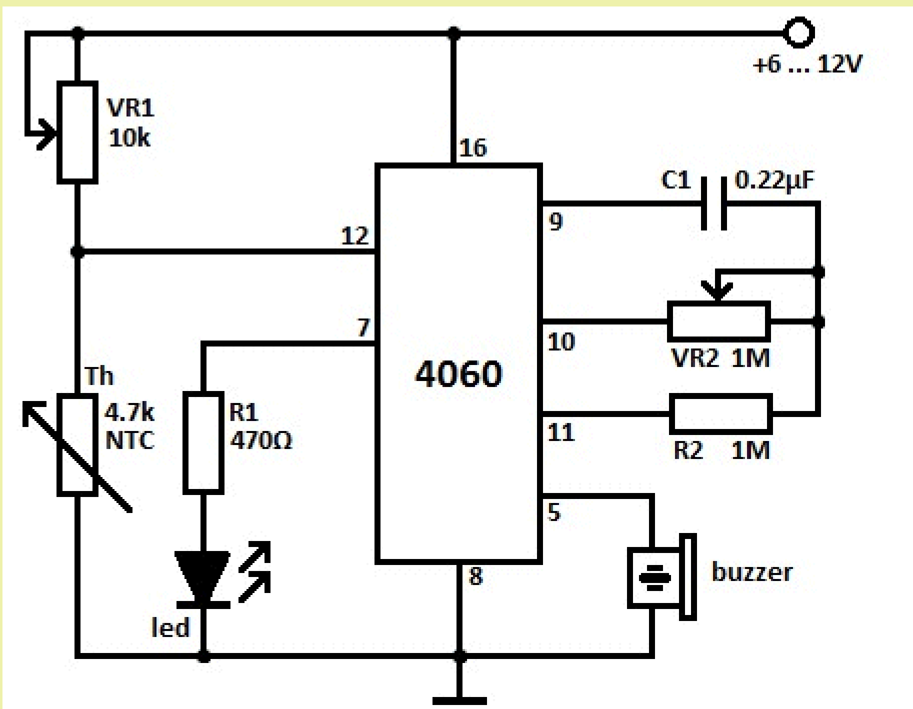
That's the skill you have to have. Instead of wasting the energy in a resistor, you should add an extra LED and use the energy as illumination.
Putting a single LED on 12v is very inefficient and wasteful.

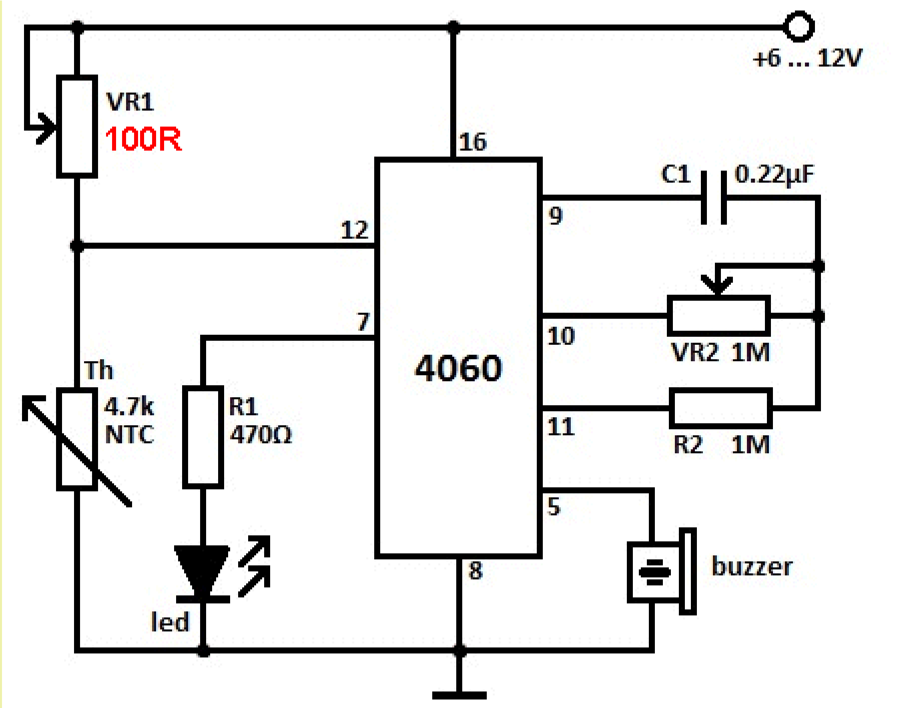
Zener Calculations by D Mohankumar



Professor Mohankumar doesn't understand how a zener supply works. And he doesn't understand how to explain its operation.
Firstly, the input voltage can come from a 9v supply with a capability of 500mA or 1 amp. Any current capability over about 100mA will work with this circuit.
He has chosen 120 ohms for the current-limiting resistor and this will allow 32.5mA to flow in the zener.
(9 - 5.1) / 120 = 32.5mA
The wattage rating for the zener must allow for the situation where the load is removed and ALL the current flows through the zener.
The zener rating must be: 5.1 x 32.5 mW = 165mW Where does he get 500mW ????
Select 400mW zener.
The output current can range from 0mA up to 25mA and this current will depend on the LOAD. The zener has no control over the output current.
The output current robs (takes) current from the zener.
If the load takes 32.5mA, ALL the current supplied by the current-limit resistor will flow in the LOAD and zero current will flow in the zener.
If the load wants 35mA, the output voltage will drop to 4.8v.
As soon as the demand rises above 32.5mA, the zener drops out of regulation and the output voltage drops below 5.1v.

HEAT SENSOR





The original circuit had 10k for the voltage divider resistor for the NTC thermistor.
A reader on the electronics Forum changed the 10k to 100R.
Let's see how this affects the performance of the thermistor.
The thermistor and top resistor form a voltage divider.
When the thermistor heats up, its resistance is reduced.
The voltage at the join of the two components is reduced.
For each degree temperature-rise, the voltage will reduce a small amount.
The value of the top resistor is important.
If it is very high, the voltage drop will we very small. If it is very low, the voltage drop will be very small !!!!
So, it can't be too high or too low.
When the resistor is equal to the resistance of the thermistor, the voltage-drop will be the largest.
WHY?
The two resistors for a voltage divider. This does not mean the voltage is equally divided. It just means the voltage is separated into two parts and we have to work out how much voltage will appear across each resistor.
When the resistors are equal, the voltage across each is the same and 50% of the supply voltage.
If the thermistor reduces to half the resistance, it will have 33% of the voltage across it.
In other words, the drop in voltage will be 50 - 33 = 17%.
If the resistor is 25% of the thermistor, the thermistor will have 80% of rail voltage.
If the thermistor drops to half resistance, it will have 66% across it. The change will be 14%.
If the resistor is 10% of the thermistor, the thermistor will have 91% of rail voltage.
If the thermistor drops to half resistance, it will have 83% across it. The change will be 8%.

The same situation will apply if the resistor is 10 times the resistance of the thermistor.
If the resistor is 10 times that of the thermistor, the thermistor will have 9% of rail voltage.
If the thermistor drops to half resistance, it will have 4.7% across it. The change will be 4.3%.

You don't have to understand the mathematics behind the analysis.
You only have to remember this: Make the voltage dropper resistor EQUAL to the thermistor to get the best results.
This will put mid-rail voltage on the join and you need to design the surrounding circuitry to detect this value. The best detector is the analogue channel of a microcontroller. You can detect as little as 1mV change.
You can also use a transistor Schmitt Trigger or Schmitt Trigger IC but remember the change occurs at about 33% or 66% of rail voltage for a Schmitt Trigger IC.

How do you select the value for the Voltage-divider resistor?

The value of the voltage-divider resistor should be the same resistance as the NTC thermistor at the temperate being detected.
Refer to a chart (table) to determine the value of the NTC thermistor at the desired temperature and select the same value for the resistor.
This will create the largest change in voltage at the join of the two components at the temperature being

detected.
This voltage will be very close to mid-rail voltage and you will need a microcontroller to detect this voltage via the micro's ADC channel.

Why hasn't this been mentioned before?

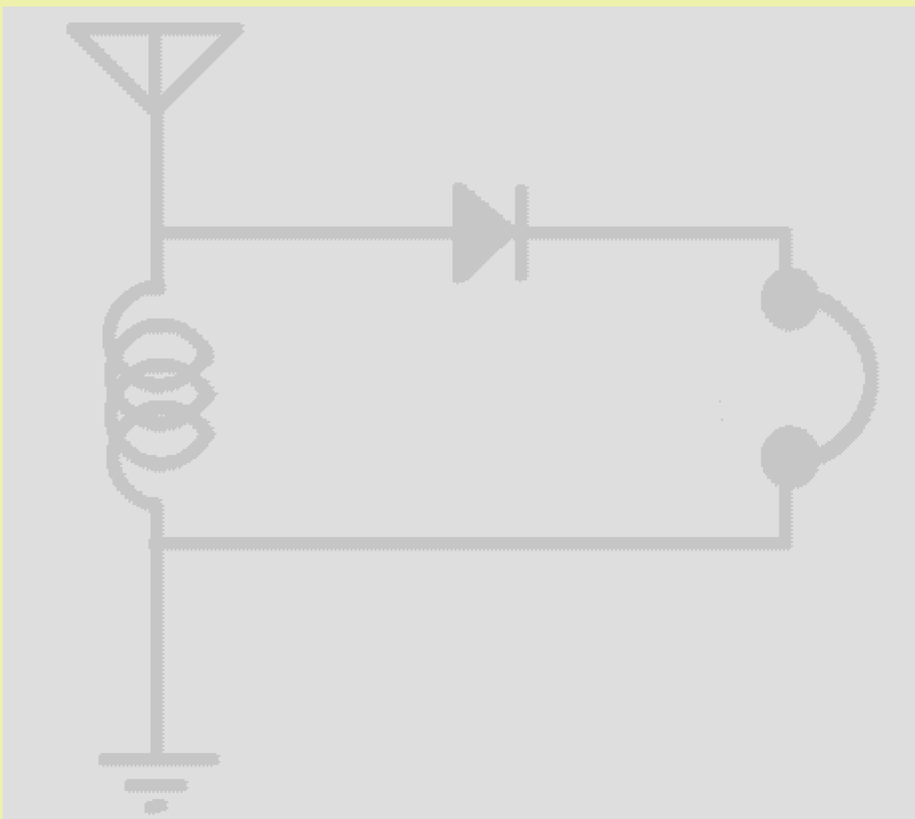
In most circuits where a component changes resistance, the change is very large and the value of the voltage-divider resistor is not critical.
A typical case is a photo resistor (also called LDR -Light Dependent resistor).
The resistor of an LDR can change from 300k to less than 1k and the voltage (at the join of the LDR and voltage-divider resistor) can be easily detected.
But when the change is very small, you need a micro to detect the mid-rail voltage.

From: http://www.doctronics.co.uk/voltage.htm

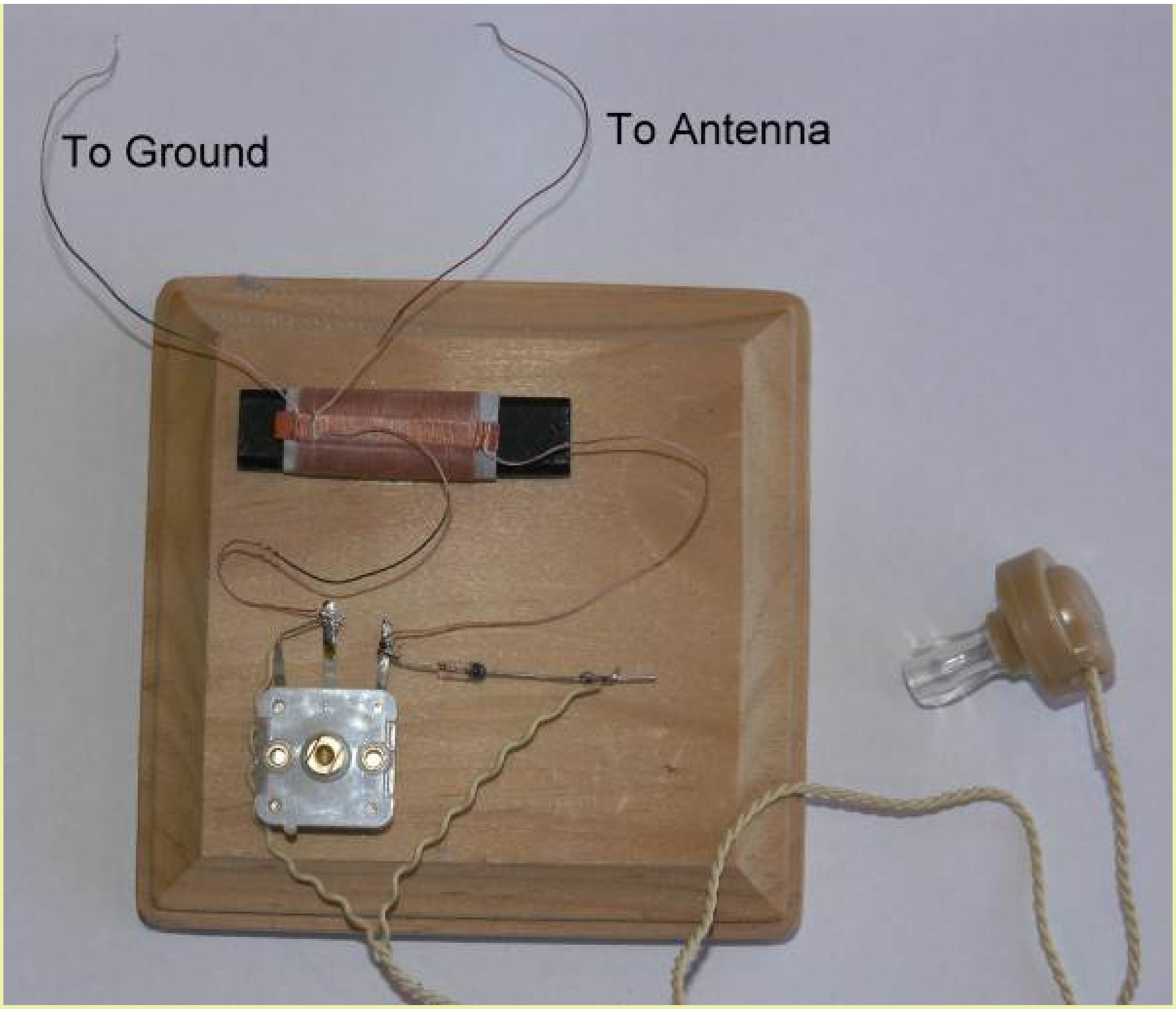
KEY POINT: The biggest change in V_{out} from a voltage divider is obtained when R_{top} and R_{bottom} are EQUAL in value.

CRYSTAL RADIO

Here's a simple circuit for a Crystal Radio. But it will not work !!

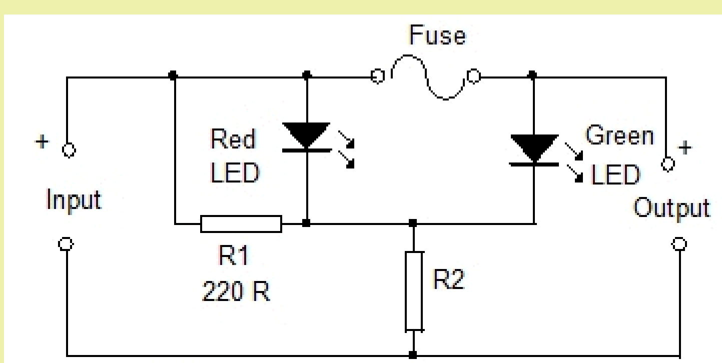


No tuning capacitor is shown on the circuit



The crystal earpiece is made with a piece of crystal with two wires attached. When a voltage is applied to the wires, the crystal changes shape.
The crystal is connected to a thin sheet of aluminium and when it moves, you can hear sounds such as voice and music.
The crystal has a very high resistance - about 10 meg ohms and you can consider it to be an OPEN CIRCUIT.
But when a signal is delivered to the earpiece, the crystal appears to be equal to a capacitor of about 20n.
This means the earpiece is just a like a 22n capacitor.
The signal picked up by the antenna and passed to the earpiece via the diode will charge the "capacitor" and when the signal reduces, the charge will remain on the "capacitor."
This means the aluminium diaphragm will move in one direction and there is no component in the circuit to discharge the "capacitor" and move the diaphragm in the opposite direction.
A 10k resistor is needed across the earpiece to discharge it ready for the next cycle.

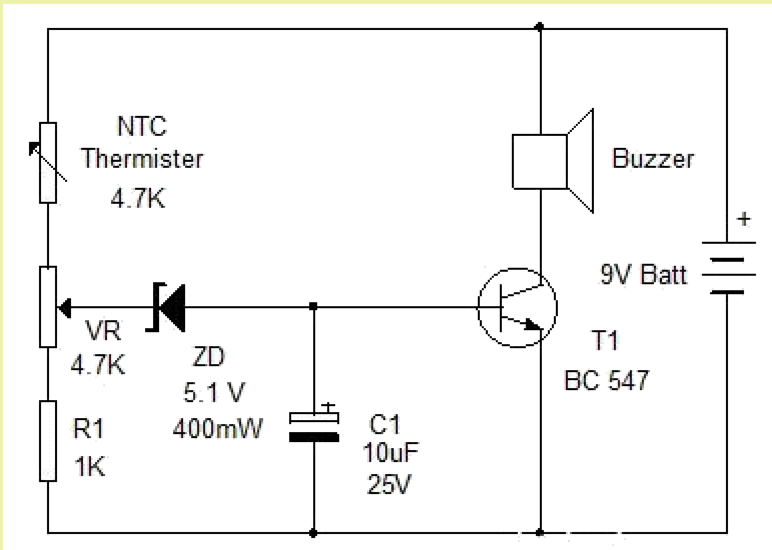
BLOWN FUSE



Here's a BLOWN FUSE circuit from Professor Mohankumar.

When the fuse blows, the red and green LED will be delivering current directly to the LOAD. A LED can only withstand a small voltage in the reverse direction and any voltage above this will damages it.
When the fuse blows, either one or both LEDs will be damaged, depending on the input voltage.
This is a USELESS circuit. It has not been tried or tested.

FIRE ALARM



Another badly designed circuit from Professor Mohankumar.

Resistor R1 is not needed. It does nothing.
The 5v1 zener can be removed as it simply changes the position of the wiper on the pot.
You cannot get a 4k7 pot. It is 5k.
C1 does nothing.

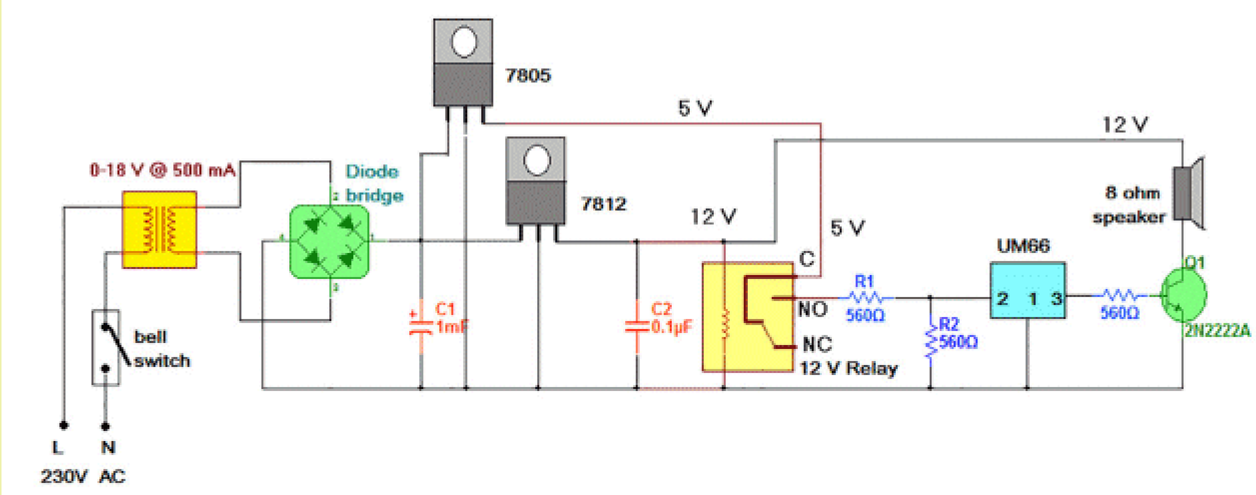
You just need the 5k pot connected to the base of the transistor.
Adjust the pot until the buzzer produces a noise.
Adjust the pot to stop the noise and use a cigarette lighter to heat up the NTC thermistor and see how much heat is required to produce a sound.
The sensitivity of the circuit will change when the battery voltage reduces and it is only an experimental circuit and MUST not be used in a real fire hazard situation. It has no beep to let you know the battery is low.

Here's two very clever names or words:

A trucking company by the name of: NEWAY
A number plate: XINNY

Did you read them correctly: ANYWAY and TINNY - referring to the original TIN LIZZY. The Ford Model T (colloquially known as the Tin Lizzie, Tin Lizzy, T-Model Ford, Model T, or T).

BELL CIRCUIT



This is the worst circuit I have seen.

Who is going to push the "BELL PUSH" for 2 - 3 seconds ???

The 12v circuit energises the relay to deliver 5v to the music chip.
You don't need the 7812 or the relay.
Who connects a "Bell Push" to the 240v - only someone who wants to KILL their visitor !!!!!

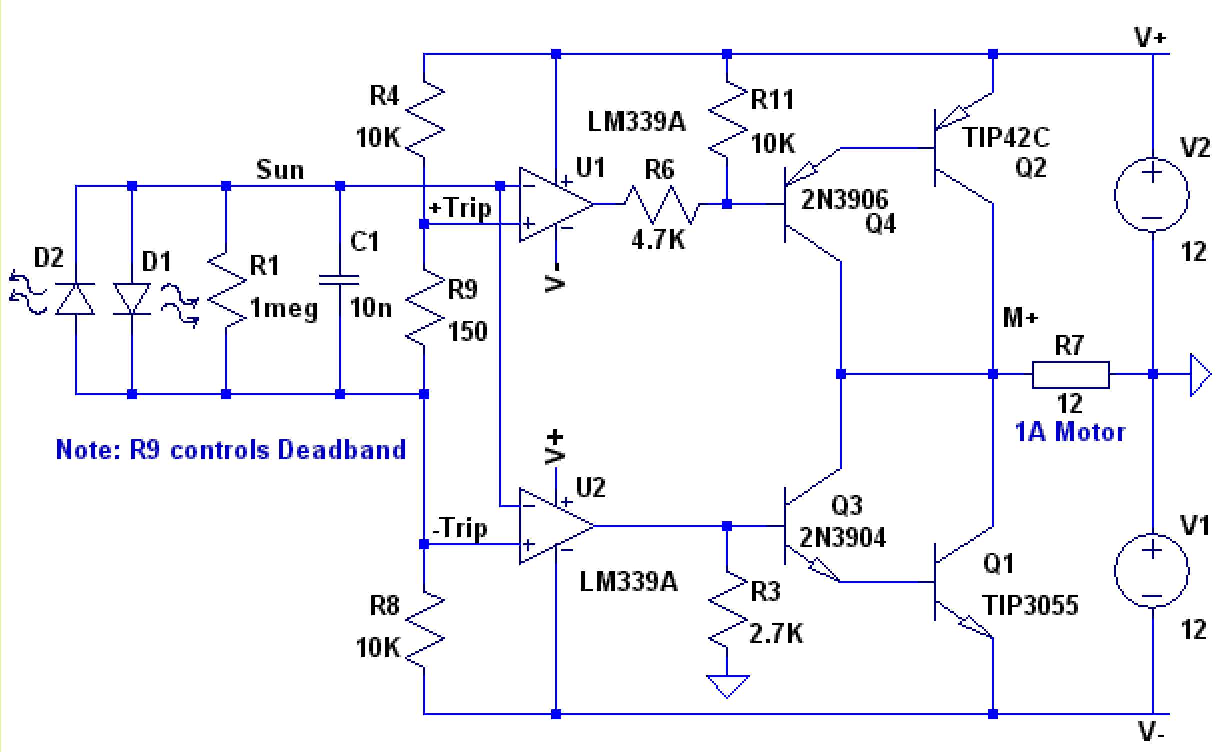
This is the worst, most dangerous, unworkable, circuit I have seen. DO NOT BUILD IT

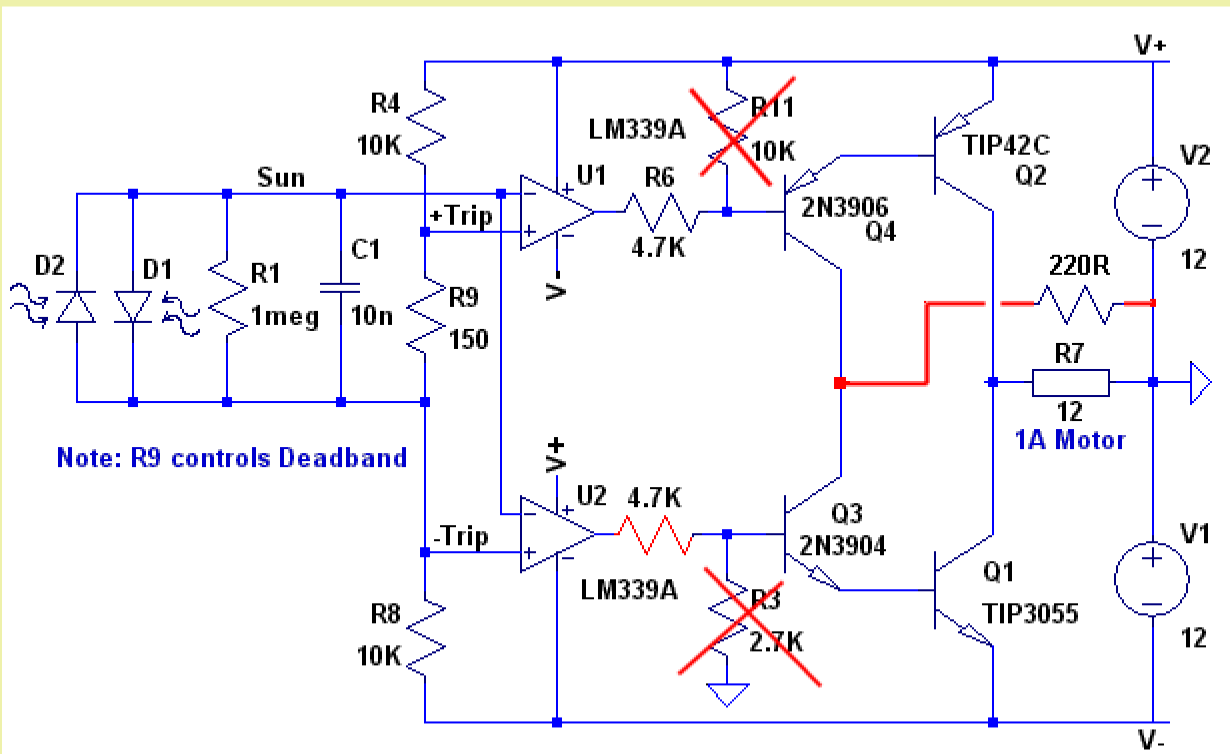
Someone on an electronics forum asked me how to measure the thickness of wire.
All the replies said to use a micrometer - they really mean a dial-micrometer.
But the cheapest and simplest way is to wind say 30 turns on a rod and compare the length with 30 turns of the new wire.
No equipment needed - just INTELLIGENCE !!!!

I'm putting a diode on a board, do I use conventional theory or modern theory?
- Chris Conrad.

All component symbols - including diodes, transistors, FETs and anything with an arrow, shows the way current will flow in the device. This is LUCKY because it helps us remember and helps us describe how a circuit works. When drawing an electrical circuit or an electronic circuit, all arrows refer to CONVENTIONAL CURRENT - this is the same as saying: ELECTRICIAN'S CURRENT or ELECTRICAL CURRENT. Where "electricity" flows out the positive terminal and into the negative terminal. We also say CURRENT flows from positive to negative. We never say VOLTAGE flows from positive to negative. Voltage is just the height of the water and when the water flows in a pipe from a high point to a low point, the flow is CURRENT. Voltage is just the pressure of the water that you can feel at the outlet by putting your finger on the pipe and trying to stop the flow of water.
If a lot of water comes out, the CURRENT is large.
Unfortunately, scientists (physicists) have found that electrons flow in the opposite direction but EVERYONE who talks about the operation of an electrical or electronic circuit, uses CONVENTIONAL CURRENT as the direction of current-flow.
If you are talking about the atomic structure of a transistor and the P-layers and N-layers and "channels" and "pinching effect" etc you talk about ELECTRON FLOW or the movement of electrons; and the flow of electrons is from Negative to Positive.

SOLAR TRACKER





The correction is shown in red. The LEDs are used to receive illumination

The designer of this circuit has used an op-amp that only "pulls-down" (called an open-collector output). This means he has had to use a pull-up 2k7 resistor.
Why use an op-amp that does not pull both HIGH and LOW and save 2 resistors.

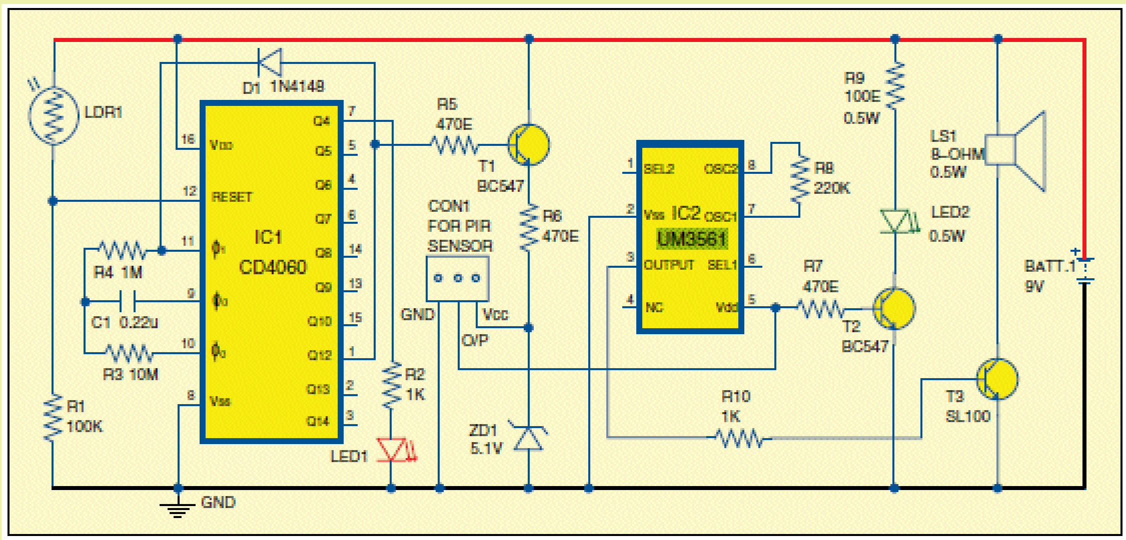
Connecting the collector of the first transistor in the super-alpha arrangement to the collector of the output transistor means the output transistor cannot turn ON fully.
If we take Q3, it cannot behave as an amplifier if the collector is not at least 0.3v above the emitter.
If the collector voltage is less than 0.3v, the transistor simply acts to pass the base current to the emitter via the natural voltage drop of this junction.
With the collector 0.3v above the emitter, the minimum voltage on the collector will be 0.3v plus 0.7v across the base-emitter of the TIP3055. This means the collector of the TIP cannot go lower than 1v.

The solution is the connect the collector of the first transistor to the 12v supply via a resistor and this transistor can now provide the gain needed to drive the output transistor.

The two super-alpha arrangements can be replaced by single Darlington transistors such as BD679 (NPN) and BD680 (PNP). These arrangements will deliver up to about 6-8 amps.

Not a very good circuit because using two 12v batteries means having to charge them separately if they are to remain connected to the circuit.

BURGLAR ALARM

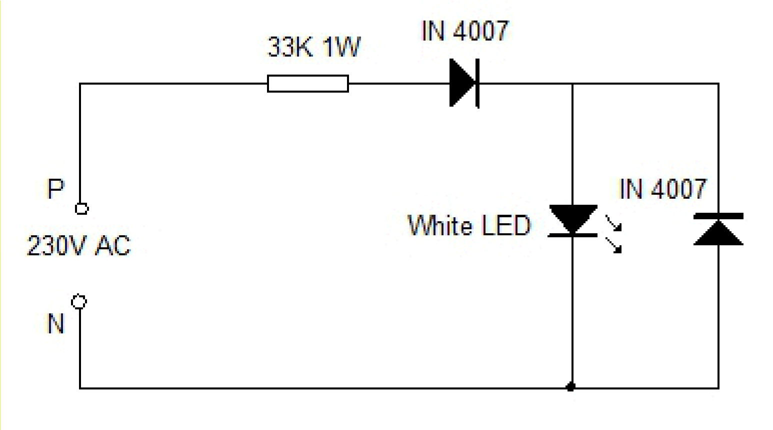


Here's another circuit from Professor Mohankumar.

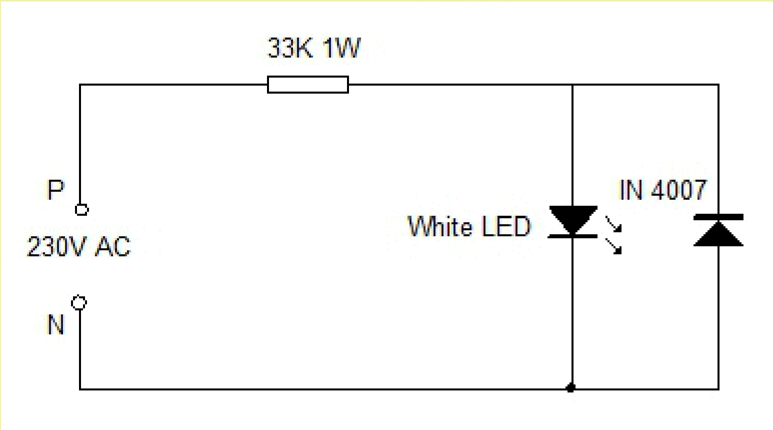
Firstly, what is the purpose of R5 ???? It can be removed.
R6 feeds a 5v1 zener.
When the output of the PIR sensor goes HIGH, R7 is placed across the zener and this effectively puts two 470R across the 9v supply so about 4.5v will appear at their join.
At the same time a 1k resistor is effectively placed from the join to 0v rail and this will reduce the voltage even further. The final voltage is unknown but the maximum for the UM3561 is 3.6v.
Even though the circuit will work, the zener has already dropped out of regulation and the voltage on the PIR detector has reduced and this may upset its operation. It has an internal 5v regulator and the voltage is already below this value. Not a very good way to design a circuit. A zener should never be allowed to dropout of regulation and the PIR sensor has an internal 5v regulator, so the 5v1 zener is not needed.

NIGHT LAMP

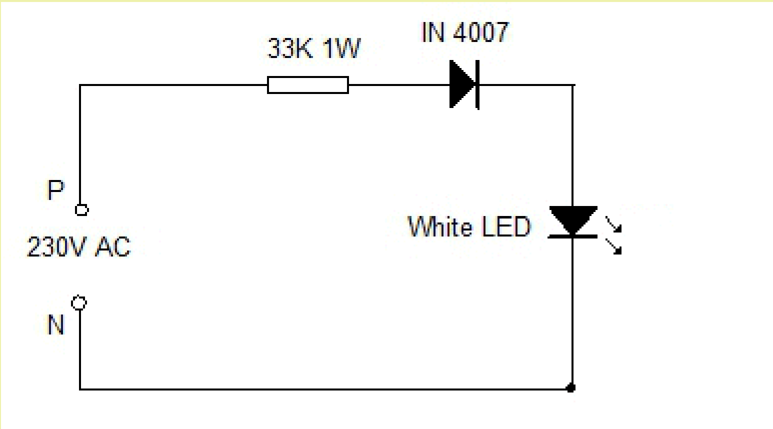
Another badly designed circuit from Professor Mohankumar.



This is the original circuit.



The top 1N4007 is not needed because it does not do anything.

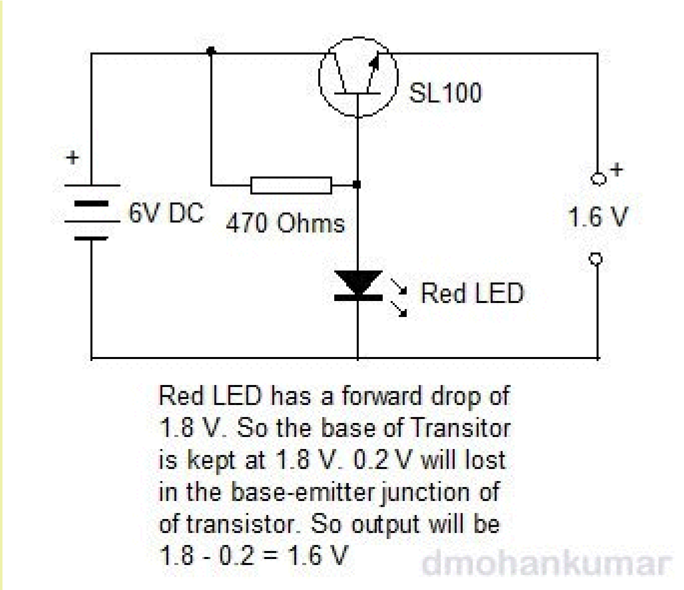


The 1N4007 across the LED is not needed because the top 1N4007 does not allow current to flow in the opposite direction and the LED is protected from reverse voltage/current.

The 33k will allow 7mA to flow, but since this is a half-wave circuit, the average current will be 3.5mA. This will not produce a very bright illumination.
None of Mohan kumar circuits have been checked or tested.

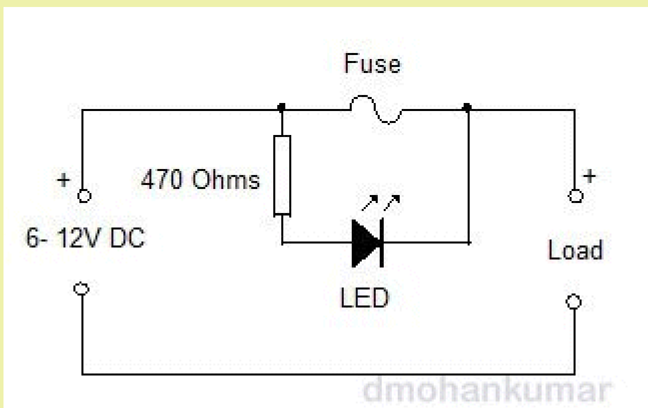
LED REGULATOR

Another bad circuit from Professor Mohankumar.



The output voltage is 1.8v - 0.6v = 1.2v   NOT 1.6v

FUSE FAIL

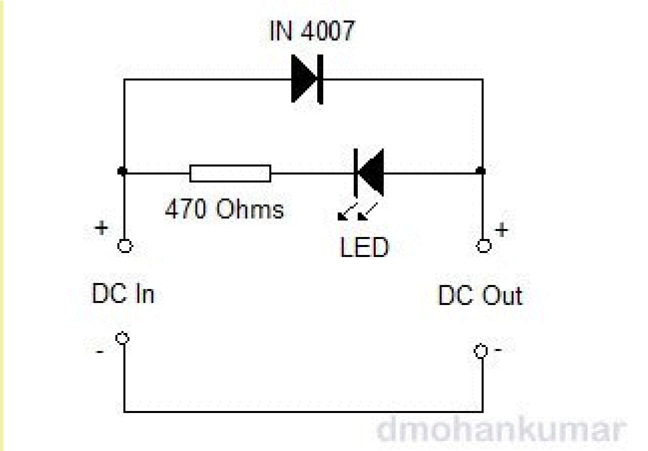


Here is the description from Professor Mohankumar:

This circuit can be hooked between the power supply and the load. When the fuse is intact, LED remains ON since it has continuity for current path. When fuse blows, LED turns off.

The LED turns ON when the fuse blows.   His description is incorrect !!!!

POLARITY INDICATOR

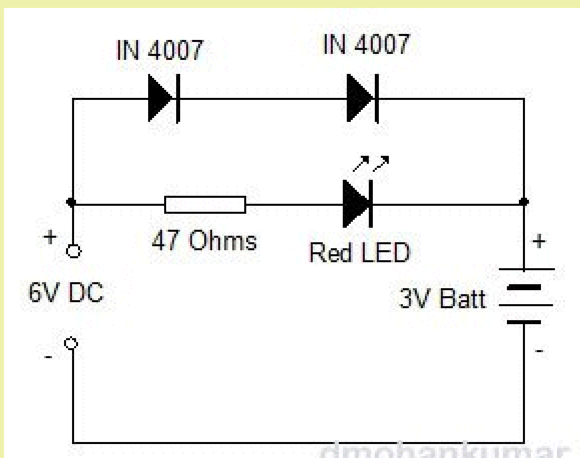


Here is the description from Professor Mohankumar:

When the positive and negative polarity of the power supply and the load are correct, LED remains off. When the polarity of the load reverses, LED turns on.

How can the polarity of a load reverse??????
The definition of a load is a device that does not produce or supply any voltage or current.
How can the Indian student get anywhere with electronics when you have a Professor spieling such nonsense.

CURRENT FLOW



Here is the description from Professor Mohankumar:

This is ideal for battery chargers. If current is flowing to the battery LED lights. It indicates whether the battery connector is properly connected or not with the charger.

The voltage-drop across each diode is 0.7v. The total is 1.4v. A LED requires a minimum of 1.7v. The LED will NEVER illuminate.
Another untried circuit.

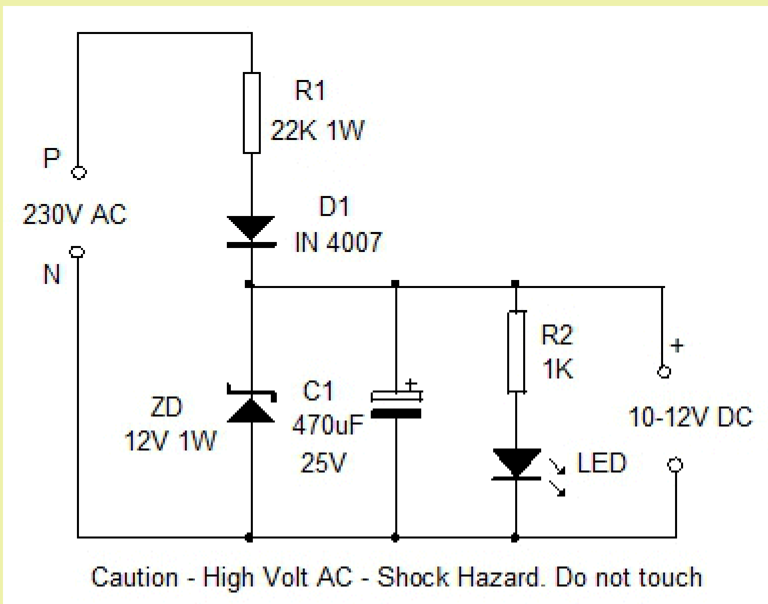
From all these simple faults you can see Professor Mohankumar - an Indian lecturer, has absolutely no idea about electronics and should not be in charge of a class or put his RUBBISH on the web.
If I was a student and found out I was being taught rubbish from a lecturer, I would be very ANNOYED.

A hobbyist has sent a technical question to Colin Mitchell.
He is using a CRO to determine the current in a LED flasher circuit.
He is using the x10 on the probe.
Here is his statement:
I see triangle wave, peak 5mV on the 10-times attenuated on the probe - in reality it's 50mV.

The x10 position on the probe is only used when the voltage being "looked at" is VERY HIGH - such as 500v or more.
The x10 setting or "position" on the probe is a slide switch that adds a 9M resistor and 1M resistor (in series) to the probe-tip so the 500v is across 10M and this becomes a VOLTAGE DIVIDER where the CRO is across the 1M resistor and thus it sees 10% of the actual voltage. Thus it sees 50v in this case.
The x10 position is not designed for 50mV viewing as the 50mV can be viewed on the x1 position of the probe.

The x10 setting on the probe has another advantage.
The input to a CRO is about 1M. If you are measuring a voltage from a flyback circuit or a capacitor multiplier, it will not be able to deliver a high current and the circuit is said to be HIGH IMPEDANCE.
Suppose the impedance of the circuit is 1M.
When the circuit is producing say a voltage of 100v, the loading of the CRO of 1M will reduce the voltage to 50v.
But when the probe is switched to x10, the loading will be only 10% and the reading will be 90v.

AC to DC



Here's another useless circuit from Professor Mohankumar.
The current delivered by the 22k will be 240 / 22,000 = 11mA for each half cycle.
This means the current available from the zener/electro section will be 11 / 2 = 6.5mA
The wattage dissipated by the 22k will be 240 x .0065 = 1.56 watts. The 1 watt resistor will burn out !!!!
This means 6.5mA will flow through the 1k resistor and produce 6.5v across it. The LED will produce 2v across it and the final output voltage will be 8.5v.
At the moment all the current is flowing through the LED and the zener is not in breakdown.
If you try to take any current from the circuit the output voltage will drop.
Remember, you can only take a maximum of 6.5mA and when you take 6.5mA, the output voltage will drop to ZERO.
Suppose you take about 1mA. This means the load will be 5k and the voltage will drop from 8.5v to 6.7v.
What a useless circuit !!!!

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SPOT THE MISTAKES!

Page 26

There is only one thing I regret with Talking Electronics website.
It should have been in the form of an encyclopaedia.
I have produced so may "pearls of wisdom" and answers to circuit problems that the website is one of the largest on the net.
And it is different to any other website or text book.
It answers all those questions left unanswered after a lecture or after reading a text book.
So may times I have read a text book and said " I don't know what he is trying to say!" Everything could be made clearer by including two or three circuits or photo's. But in many cases the author has never built the circuit and tested it.
The biggest mistake a beginner can make is thinking a text book will answer his questions, solve his problems or teach him electronics, or a course will enable him to become a technician.
A current Masters of Electronics course in Australia runs for 4 years and in the first three years the students have done little or no soldering, and only worked on a very poorly produced PC board for an AM radio.
Their final project is to produce a robot that finds and picks up pucks.
I don't know how many pre-made modules are allowed or if a whole Robot can be bought off-the-shelf, but how is a student going to design and produce a robot with steering, detecting a puck, picking it up, two-way remote control, camera-detection and programming a microcontroller, in 6 months.
No-one with less than 2 years ROBOT ENGINEERING and hundreds of projects under his belt, could come up with a project like this.
It just shows the absurdities of University teaching.
They think you can come out of the course with all the capability of designing a robot for the Moon Lander, after a single project; while in reality the student can barely desolder a 40 pin IC.

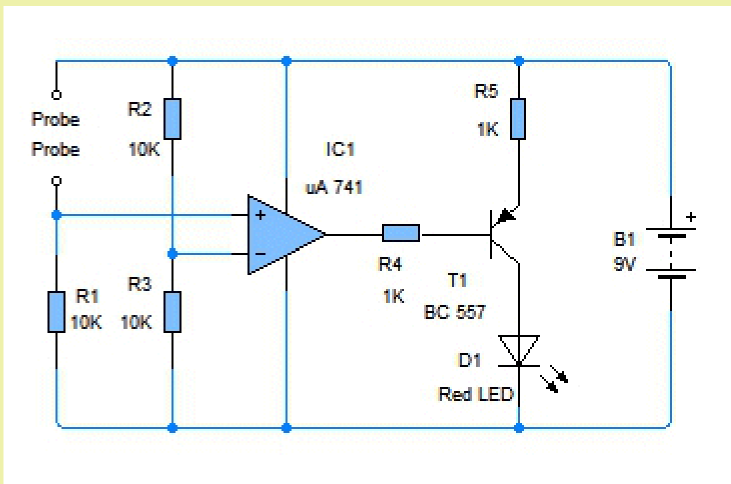
After helping 4 electronics forums for the past 3 years, I can say the actual basic understanding of electronics of those who have been in the industry for up to 40 years, is quite lacking.
Yes, many of them have carried out research, repaired thousands of pieces of equipment or worked in electronics at the hobbyist level, but some of the replies and answers to readers questions contain fundamental, glaring, errors.
I don't know everything about electronics but I have certainly covered a lot of the basics and explained things that have never been covered before.
And it's only when you cover a circuit in minute detail that you can explain its operation.
It's only when you can "SEE A CIRCUIT WORKING" that electronics comes alive and you can actually work on the circuit to improve its performance or alter its characteristics.
The next stage in the development of the web will be to produce interactive discussions with circuits that "move" and show the capacitor charging and the transistors turning ON and the IC's carrying out a function.
This can come with short videos showing the circuit working and include the sound.
Some of the simulation software already shows "electrons" moving around the circuit but none actually show the resistor limiting the current or the capacitor charging or the transistor turning ON.

The one thing I liked about Radio Shack (Tandy) was the "Lifetime Guarantee" they provided for their products.
I don't know what a Lifetime Guarantee means but the concept infers that any problem will be addressed and fixed.
The stores were a very poor example of an electronics component supplier and they lurched from one decade to the other with a few successful products such as stereo amplifiers, CB radios, loud hailers, 200 electronics experiments kits, Gold Detectors, computers and then everything died.
But the concept of a guarantee still stays in my head and for anyone who has bought a kit from Talking Electronics and not been able to get it to work, the policy exists to be able to send it in for checking and repair at no cost.
Some readers have bought $200 worth of kits and are not heard-of again. To get all the kits working will require a lot of skill and since many were beginners, they should have contacts us for assistance.
It's no good giving up and letting anything rest as you only begin to learn electronics when you have found and fixed a fault.
I have fixed over 26,000 black and white TV's and if I gave up after a few minutes, almost none of the sets would have been fixed.
Sometime it takes hours to locate a fault and something it is just replacing a cracked valve.

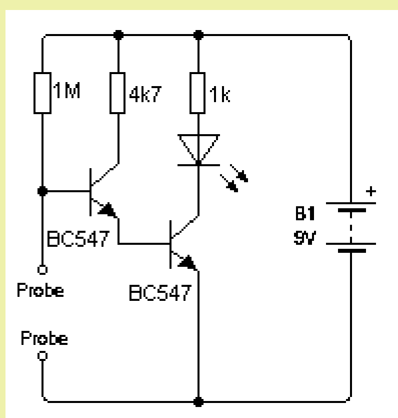
But dogged determination is the only attribute you need to see your way through a design . . . to eventual completion.
It would be wonderful if everything was easy and straight-forward.
But that means the product and idea would already be on the market.
New ideas take skills that have not yet been tested and and since everyone's brain has an endless capacity for invention, new ideas and products will come on the market all the time.
It's just your aim to make that new product . . . yours !!

PLANT WATERER

Another circuit from Professor Mohankumar. The probes are placed in the soil of an indoor pot-plant and the LED comes ON when the soil dries out.



The circuit above is the original design. It works but it is very complex and the op-amp takes current all the time.



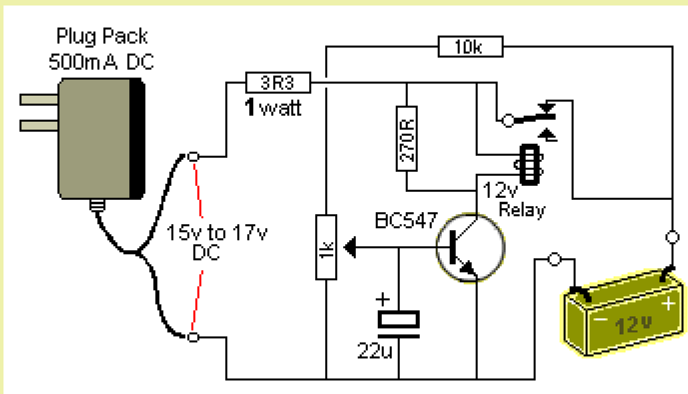
The circuit can be simplified to two transistors and 3 resistors. It takes less than 9 microamps when "sitting around."
When ever you design a circuit, look on the web to see how it has already been designed and ask yourself if any of the components can removed and if the circuit can be simplified.

Spot the Mistakes pages allows me to talk about things that can't be added to any of the other sections.

No text book and NO project in a magazine has ever included a section "If it doesn't Work" Everyone expect a project to work for EVERYONE.
And how wrong they are.

There are so many variables to making a circuit.
Many projects are just on the verge of not working and by using a different transistor or a different component or even a different layout, the circuit fails to work.
I have already given examples of poorly deigned multivibrator circuits that I could not get to operate and others that stopped working as soon as the voltage dropped a few volts.
That's why I consider these pages one of the most important additions to the website.
You can learn 10 times faster from other people's mistakes than dragging yourself through the theory of the circuit.
I have proved this with 2 apprentices who came "off the street" and were fixing black and white TV's after 2 - 4 weeks of watching what to do.
Of course you can go the "theoretical route" but this route will have much more significance if you have already experimented with the circuits and seen what effect is produced when components are changed.
And you have a much better "grass roots" understanding.

AUTO BATTERY CHARGER

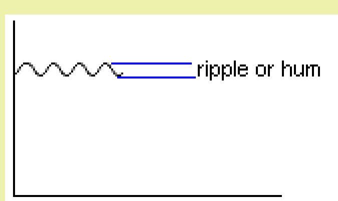


This is not a faulty circuit but the simplest **Automatic Battery Charger** circuit you can get.
It is so simple, that no one believes it will work.
It is mainly designed to keep a battery topped up in a car, motorcycle, snow-plough, etc stored in a garage for a number of months.
A battery loses energy at the rate of 10mA to 100mA, depending on the battery and the temperature and the age of the battery and you need to keep adding this energy to keep it charged.
This circuit will not overcharge the battery because the charging current is less than 500mA and the current is turned off when the battery voltage reaches 13.7v.
Read the full article: Automatic Battery Charger and you will see how the circuit works. It is quite complex.

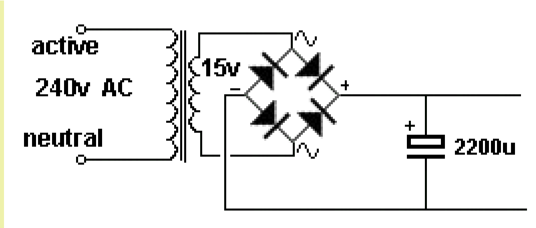
HUM

Hum is the background noise you hear in an amplifier when the volume is turned down.
It comes from the power supply where the diodes charge a set of electrolytics from the alternating current (AC) from the "Mains." The Mains is called the "AC."
If the Mains has a frequency of 50Hz, the power supply produces 100Hz hum and if it is 60Hz, the frequency is 120Hz. This is because the bridge delivers the waveform from the 0v axis to the peak of the waveform to the output and at the same time it inverts the wave (from the 0v axis to the negative peak) and places it between each of the positive portions of the wave and this effectively doubles the frequency.

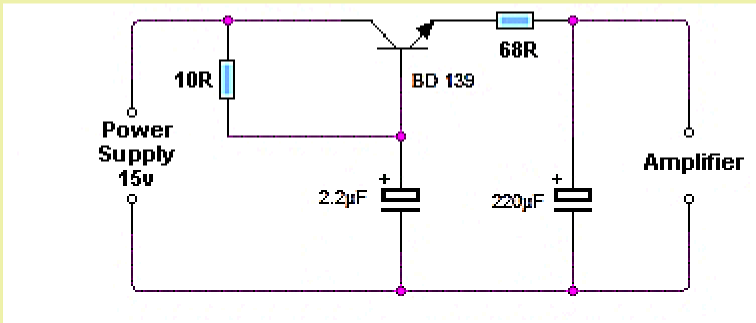
Hum is the ripple at the top of the voltage coming from the power supply:



Suppose the hum is the voltage between 13v and 15v. If we use the voltage up to 13v, we will not get **any** hum.
Here are 3 circuits and we will explain how well they perform.



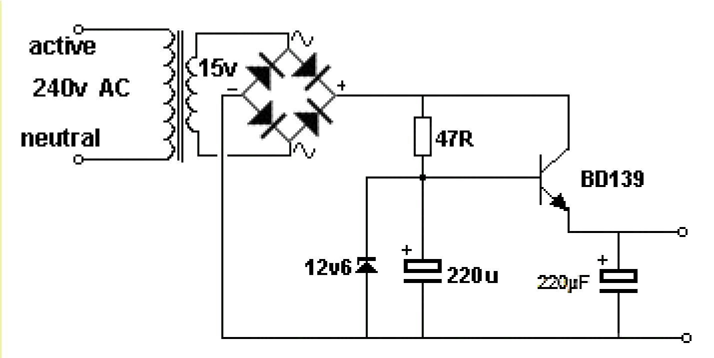
This circuit will deliver all the hum to the load. If the load is an amplifier, the background will hum.
It delivers the full voltage from the power supply, including the HUM component.



This circuit will deliver some of the hum to the load.
The voltage is delivered (including the hum component) and
the hum component is reduced slightly by a process called SMOOTHING.
The output voltage is reduced by a process called ATTENUATION.
But the hum is not REMOVED.

The 10R and 2u2 will have a small effect on reducing the hum and the emitter will deliver the improved waveform to a 68R and 220u filter. But the voltage at the join of these two components will drop when a load is applied and this is not a good design for a power supply.
There are two faults with this circuit.
The transistor increases the effectiveness of the 2u2 by 100 times, so why not make the 2u2 larger.
if it is 220u, it will effectively be equal to 22,000u and provide very good hum reduction.
The 10R should be increased to 220R to improve the effectiveness of the 220R/220u combination.
The 68R will lower the output voltage and at 100mA current, the output will drop 6.8 volts !!
Obviously, this is not a very good circuit.

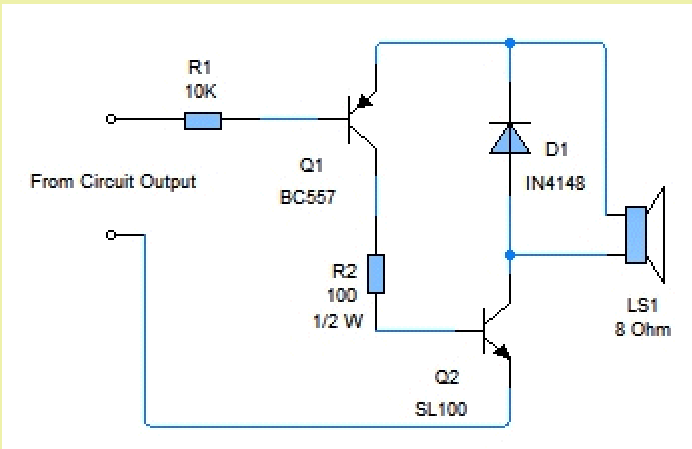
The third circuit combines the first two circuits and adds a zener diode to deliver only the voltage below the ripple. The voltage below the ripple is perfectly smooth.
The zener and 220u creates a very stable 12v6 and this is fed to the transistor. We could use this stable 12.6v and feed it directly to the load but as soon as we require more than 100mA, we will be taking all the current from the zener and the output voltage will drop.
At the moment the supply voltage is about 18v from the bridge rectifier, and this creates 5v across the 47R. The current through the 47R is about 100mA and this current flows through the zener.
This is the maximum current we can use and if we take say 120mA, the zener DROPS OUT OF REGULATION and the voltage across it drops to a lower value. So, we can NEVER take more than 100mA from the stabilization-section of the circuit - the zener diode.
The transistor has a gain of about 100 and theoretically we can take 100 times 100mA (=10Amp) but the power supply will not deliver this high current so with a current up to 1, 2 or 3 amps, the output voltage will be fully stable. (The bridge and transistor are 3 amp devices.)



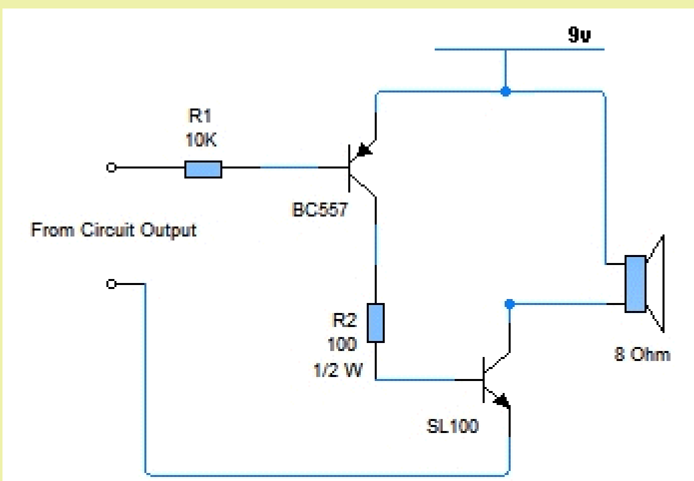
The final circuit using a zener and transistor to
provide a stable output voltage, with the hum removed.

AMPLIFIER

Another useless circuit from Professor Mohankumar.



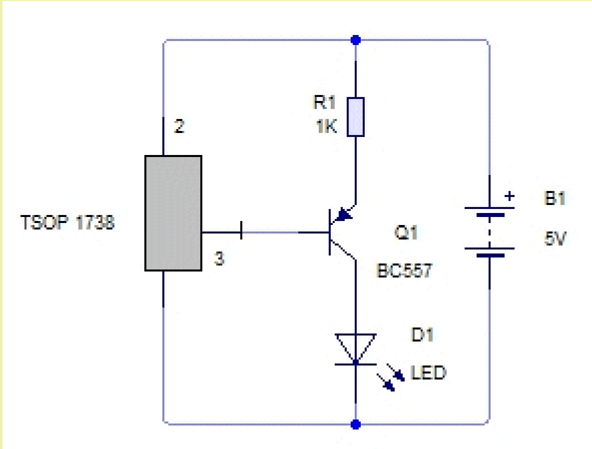
The circuit has no supply rail.

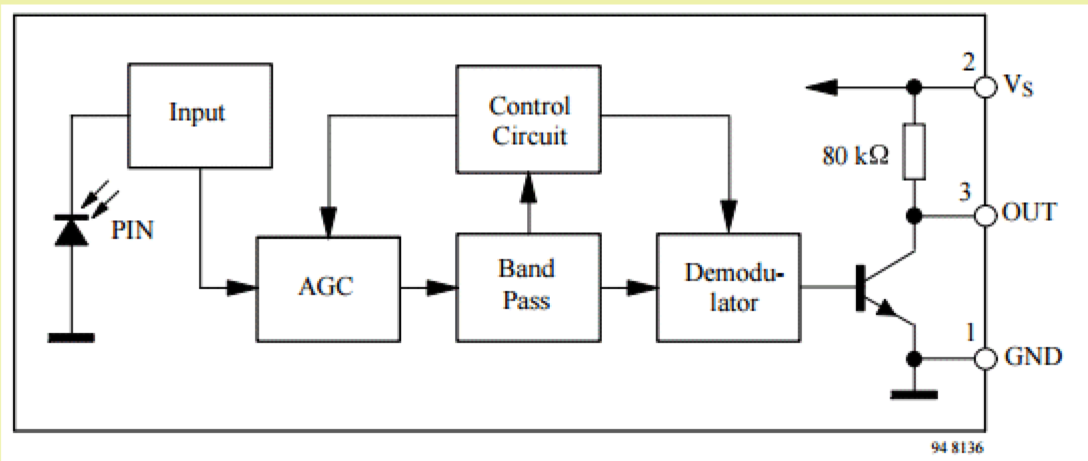


The diode does nothing and been removed. The supply rail has been added.
The circuit is absolutely USELESS.
The only time when the circuit acts as an amplifier is when the input voltage is between 8.2v and 8.4v.
At all other times the amplifier is turned OFF or fully saturated.
Where can you get a signal containing audio information between 8.2v and 8.4v ???
Another untried, untested, useless circuit from an Indian "Professor."

IR DETECTOR

Another useless circuit from Professor Mohankumar.

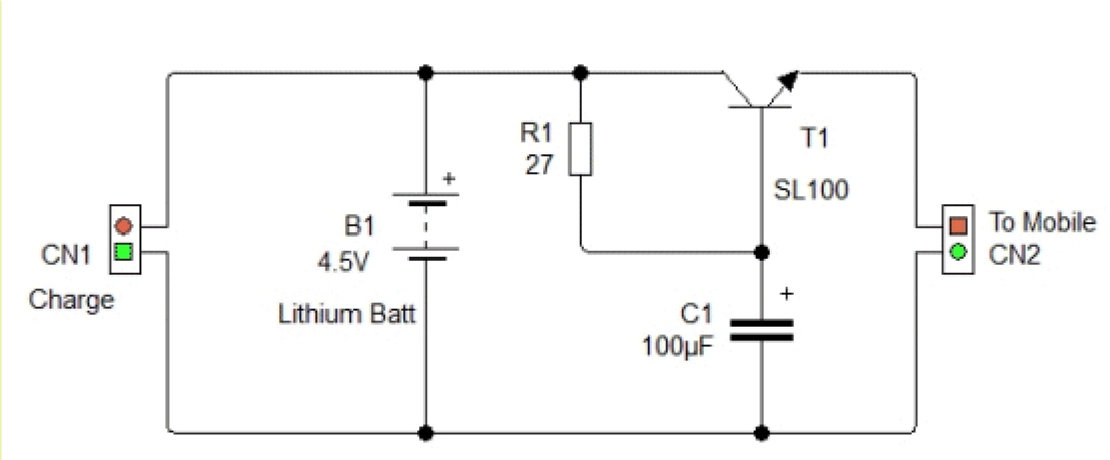




Look at the block diagram.
When the output transistor is OFF, pin 3 is HIGH and the BC557 transistor is not turned on. The LED does not illuminate.
When the output transistor is ON, the voltage on pin 3 is about 0.3v and the base of the BC557 transistor will be 0.3v above the 0v rail.
The emitter of the BC557 will be 1v above the 0v rail and the collector will be 0.8v above the 0v rail.
The LED will not be turned on.
The LED will NEVER be turned ON !!!
Another untried, untested, useless circuit from Professor Mohankumar.
Where does he get this rubbish from????

PHONE CHARGER

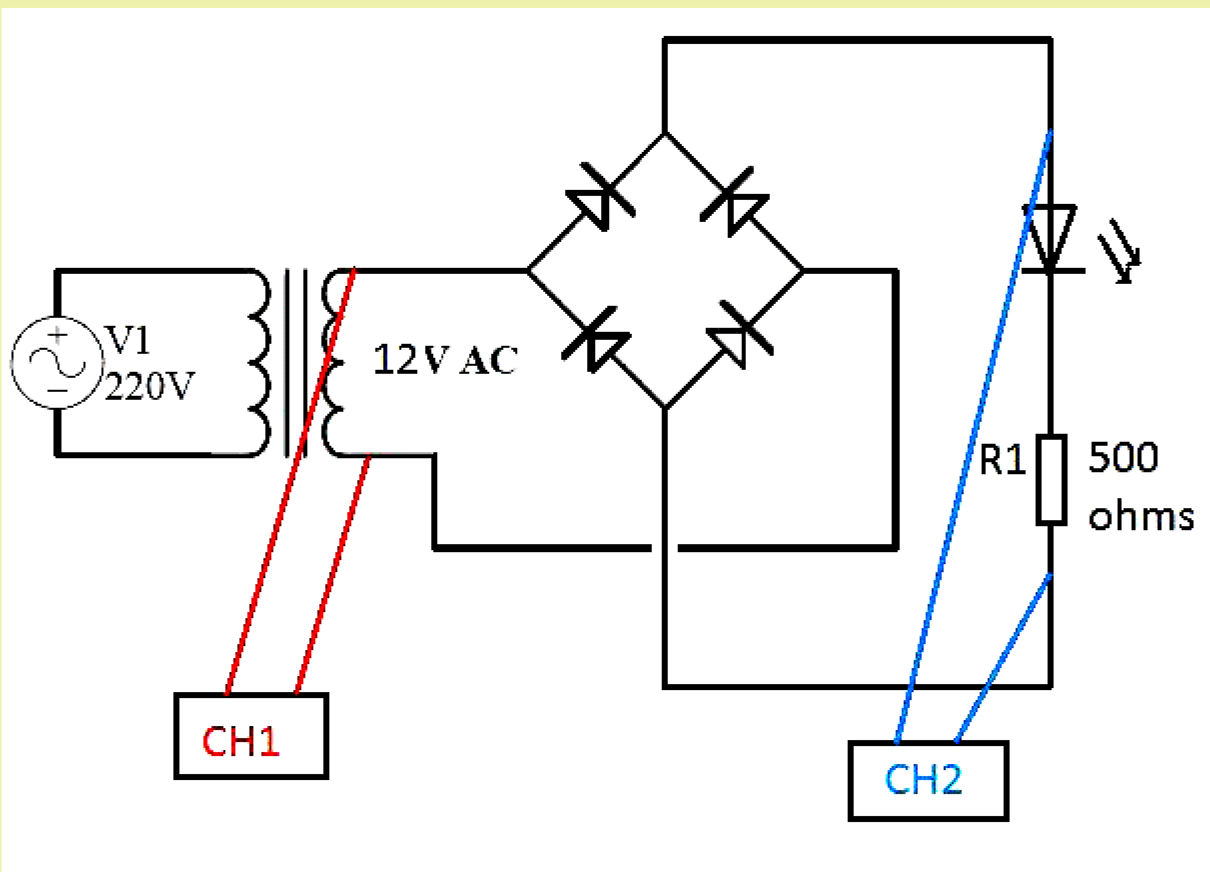
Another useless circuit from Professor Mohankumar.



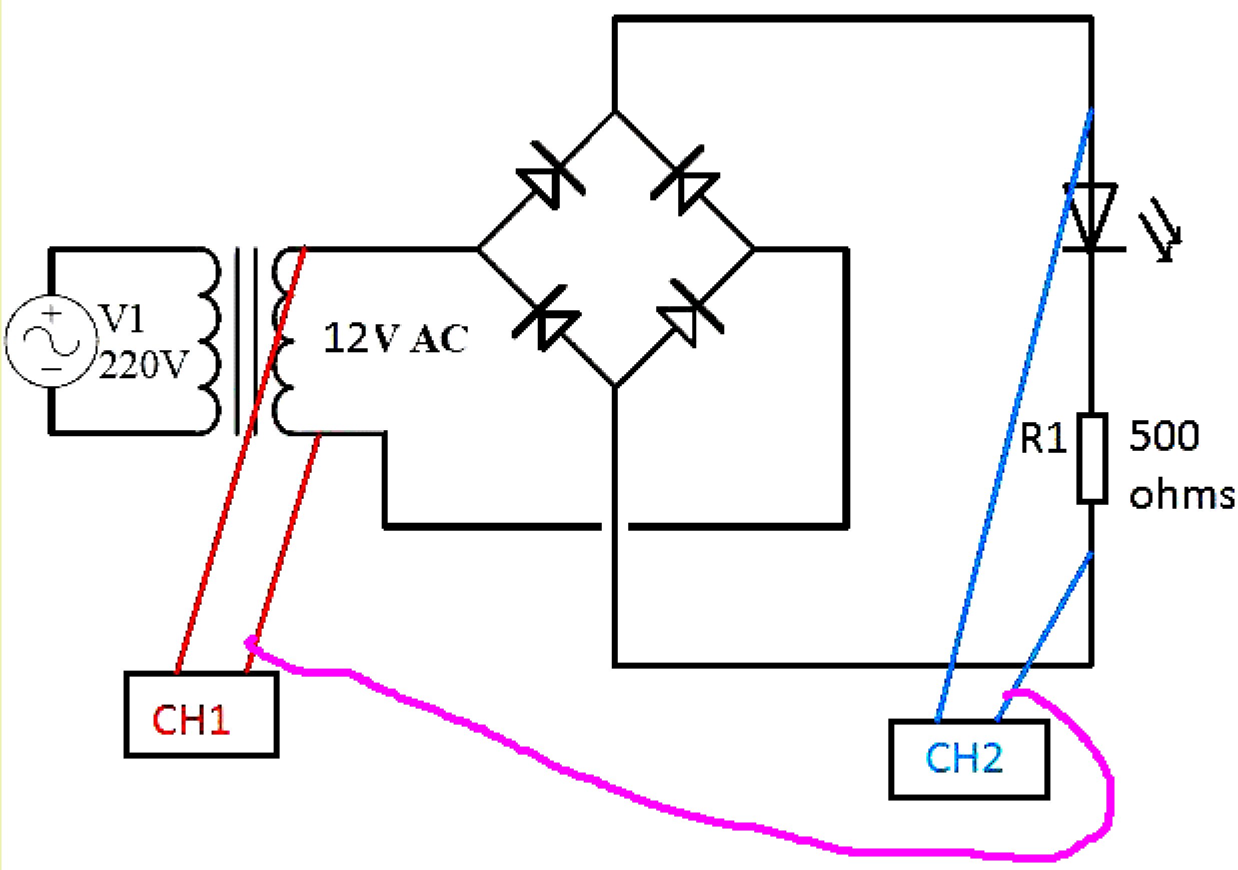
I don't know what this circuit is supposed to do but it will not work.
The output of the circuit is 3.8v as 0.7v is lost across the base-emitter junction of the transistor.
A mobile phone needs 5v because it has a protection circuit and also a current limiting (called the charging circuit) between the input and the battery.
The battery is 3.6v and if the input voltage is 3.8v, NO CHARGING WILL OCCUR.
This circuit simply WILL NOT WORK.

CRO PROBLEM

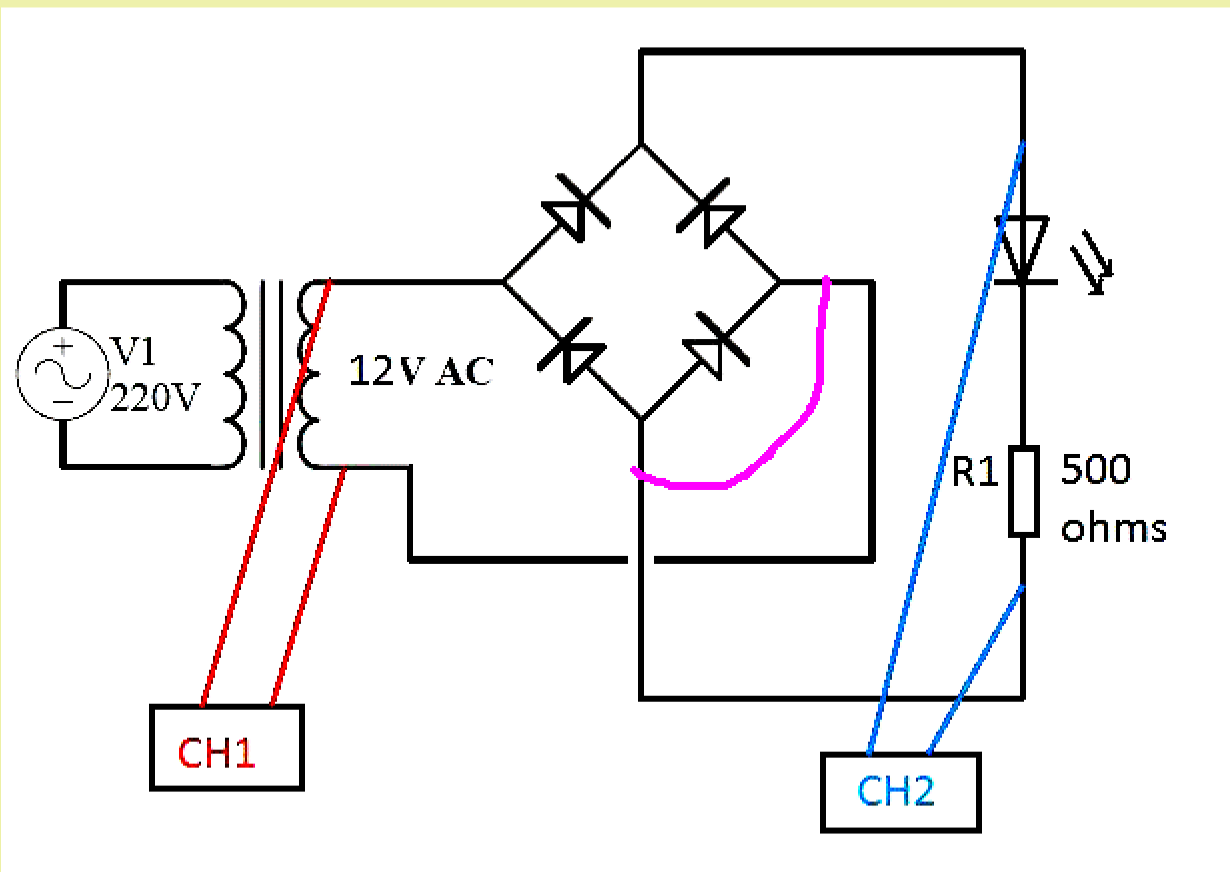
A reader is testing a power supply with a dual-trace CRO and placing the probes as shown:



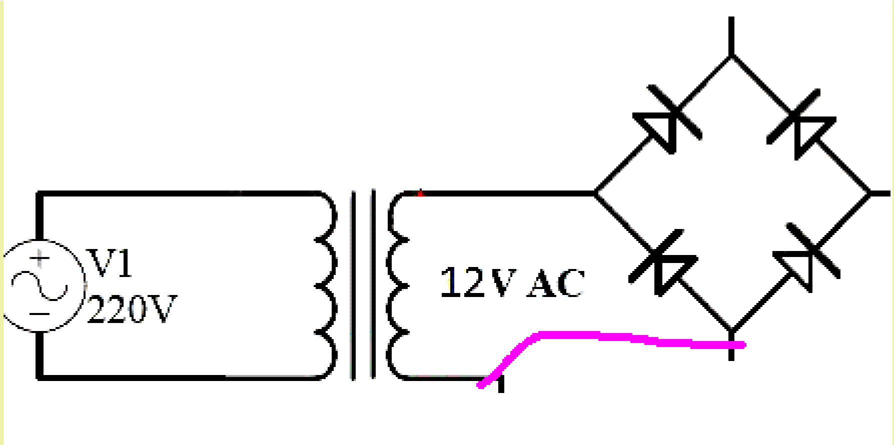
When the power supply is turned ON, one of the diodes is damaged.



The earth lead on the probe for Channel 1 is connected to the earth lead on Channel 2 and the purple line on the diagram above shows this.



The diagram above shows the "short circuit" on the power supply due to the two probes.

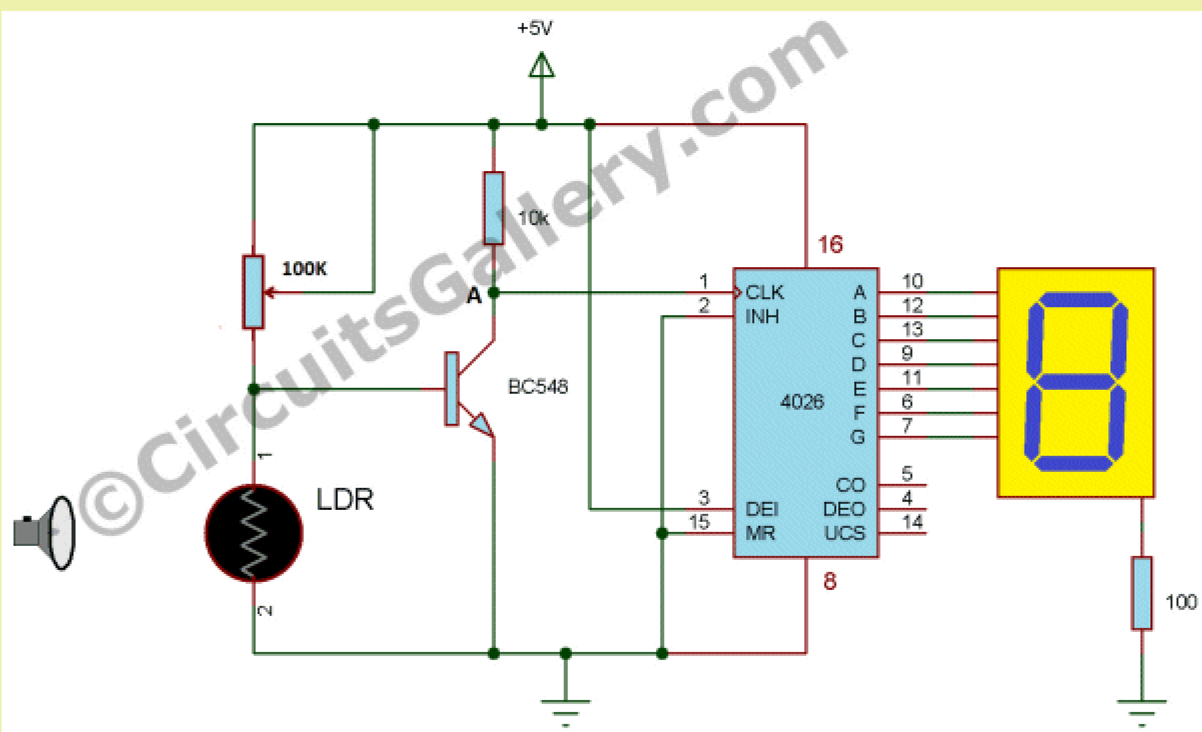


The diagram above shows the "short circuit" puts a singe diode across the incoming 12v AC and the diode presents a "short circuit" when the voltage is emerging in one direction and will be damaged. When the voltage is emerging in the other direction, the diode is reverse-biased and nothing happens, but when the voltage reverses again, a very heavy current flows.

This is just one of the dangers of connecting two probes to a circuit.
In the circuit above, the voltage emerging from the transformer is classified as "above earth" (this can also mean "below earth") and means the voltage is not an "EARTH POINT."
The other point is not strictly an EARTH POINT but we have made it an **earth point** by connecting the earth probe.
In all circuits and PC boards that have an "earth plane" or "ground plane," this trace or track or plane is not necessarily "earth" as it may have no connection to the earth pipe of your house via any wiring.
But as soon as you connect the earth probe of a test probe to the track, it becomes EARTH via the CRO.
This is now your reference point for all other voltages.
This is very important to remember when you have hum problems with an amplifier, especially when you are designing an amplifier and connecting it to a power supply.

COUNTER

Here is a counter circuit with a number of mistakes.



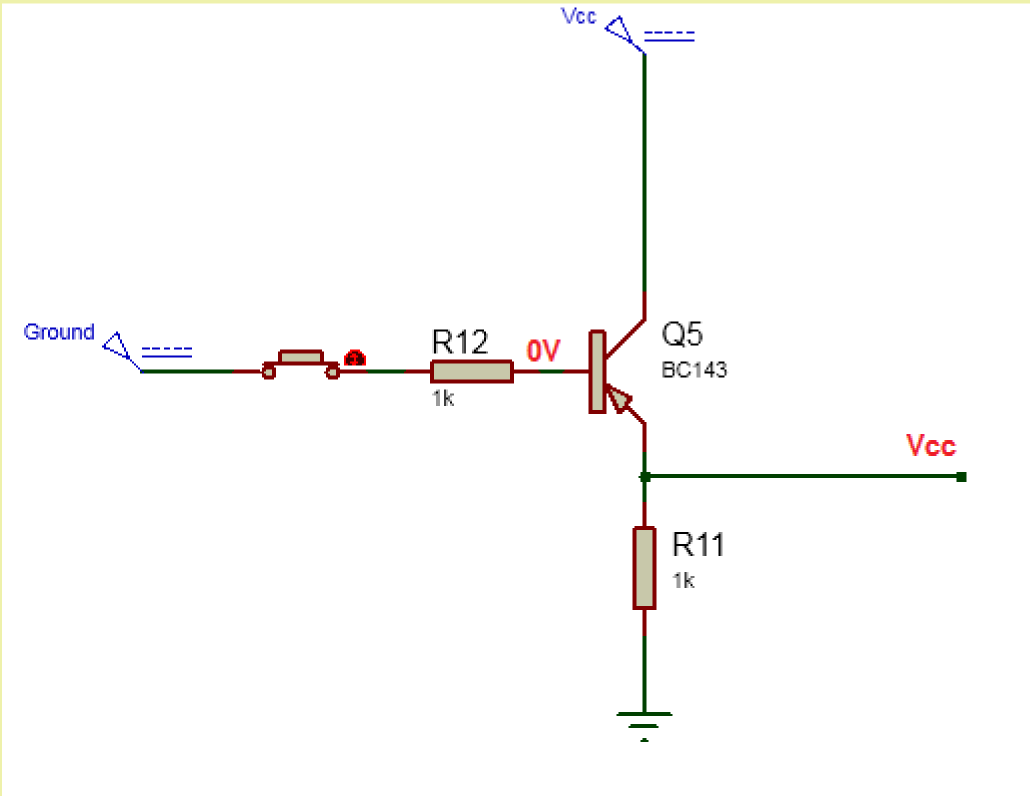
If the 100k pot is turned fully clockwise, the pot and the transistor will blow up.
The circuit has no debounce and the count may increment by an unknown number if the LDR receives varying

light intensity.
The display will dim on the figure 8 due to the 100R in the "common" line. As more segments are lit up, the voltage across the 100R increases and each segment will pass less current.

TRANSISTOR TESTER

Here is another INDIAN website for beginners. It is filled with mistakes:
http://www.circuitsgallery.com/2013/12/transistor-tester-circuit.html

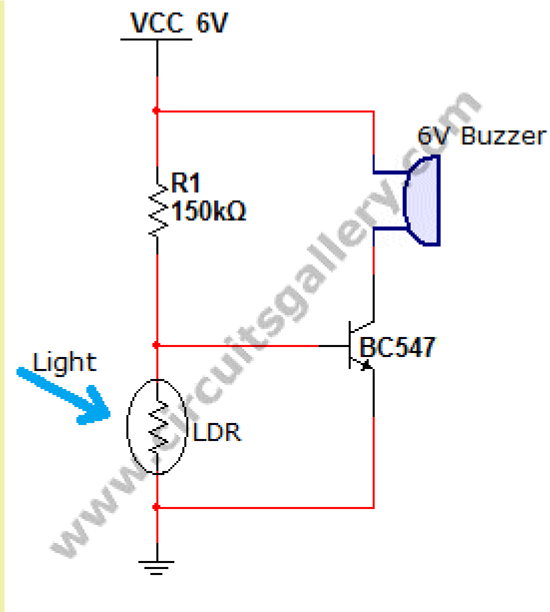
Look at this PNP circuit:



The transistor is connected AROUND THE WRONG WAY !!!!

HOME ALARM

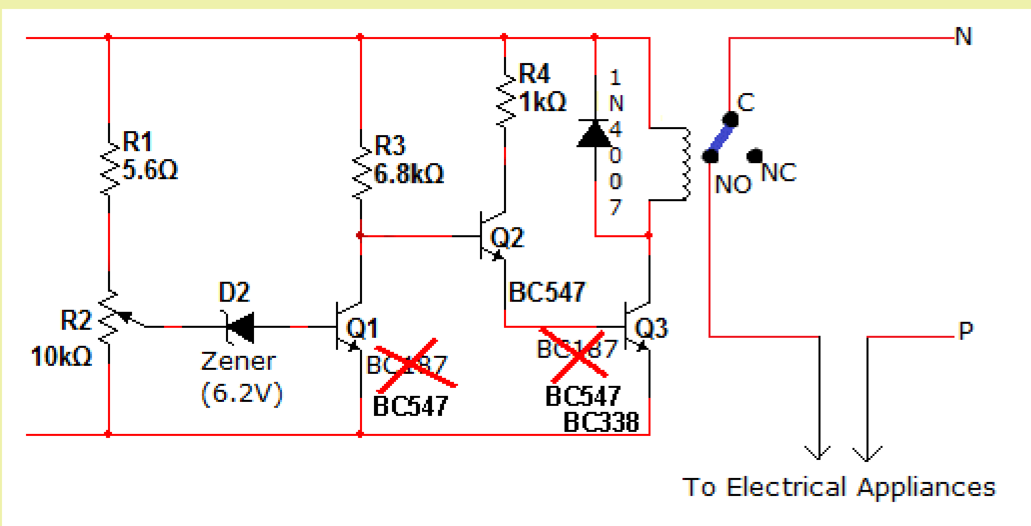
Here is another circuit from the INDIAN website:



The circuit contains a fundamental mistake.
The transistor effectively reduces 150k by a factor of 100 or 200 as this is the gain of the transistor.
The 150k becomes 1k5 or 750 ohms in series with the 6v buzzer.
This means the circuit will pass between 4mA and 8mA.
The buzzer will not be very loud.

OVER VOLTAGE CUT-OUT

Here is another circuit from the same INDIAN website:

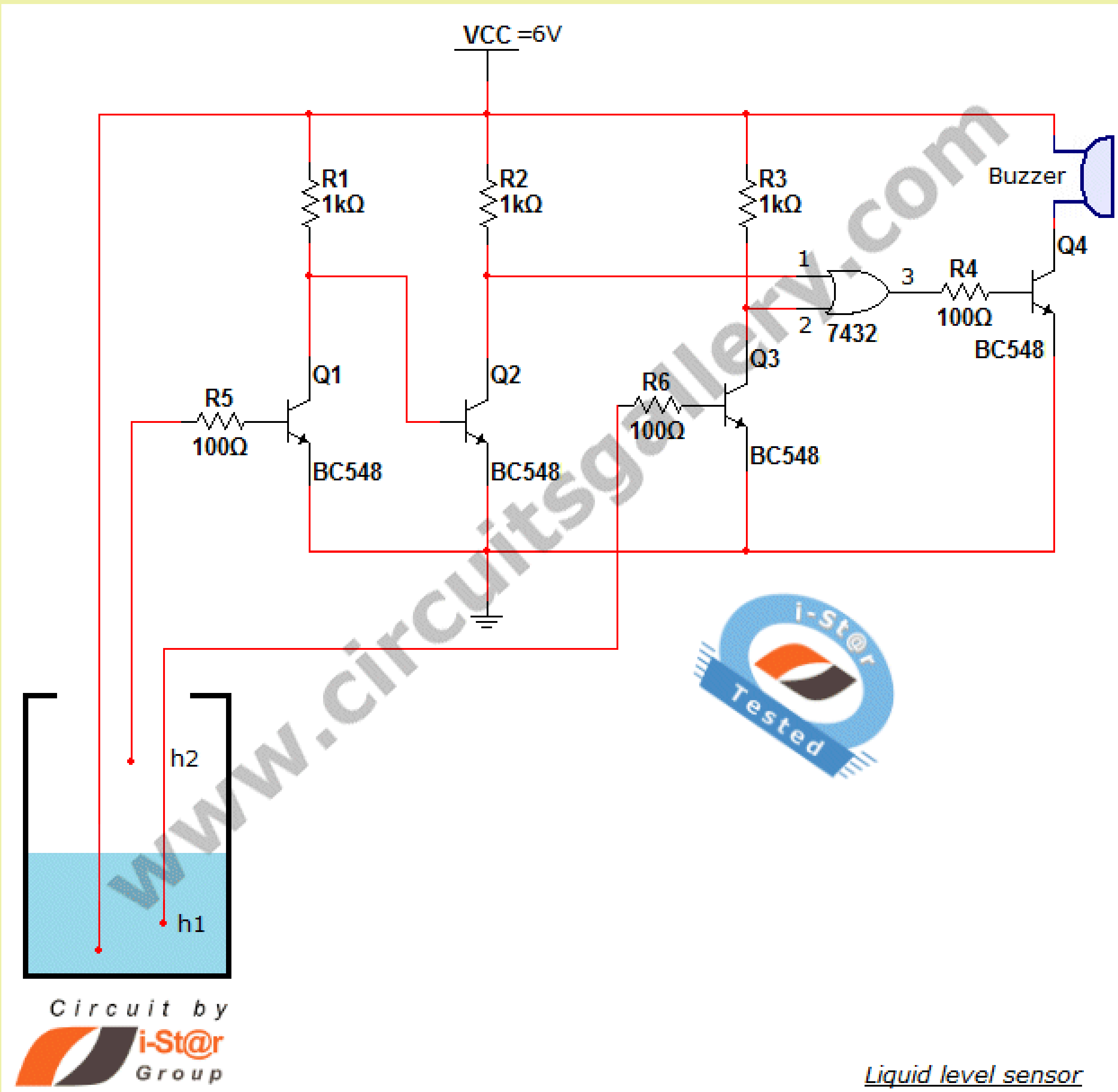


The 6v2 zener is not needed. Here's why:
The circuit is detecting the voltage on the power rail and when it rises too much, Q1 is turned ON and Q2, Q3 are turned OFF.
The rise in voltage on the power rail is passed to the base of the first transistor via a voltage divider made up of R1 and R2 and through a 6v2 zener.
The pick-off voltage from the 10k will be about mid-rail voltage and this means for every 2mV rise in the supply voltage, the pick-off voltage will rise 1mV.
The voltage drop across the zener is not fixed. When the current is very small the voltage across the zener is less than 6v2 but it an unknown value and it will rise slightly as the current increases.
This means it will take a few mV rise on the power rail for each mV increase on the base.
If we remove the zener, the pick-off voltage will be about 0.7v and this means it will take about 20mV rise on the supply rail for each mV rise on the base.
However the circuit does not need to detect very small rises and it will be quite acceptable without the 6v2 zener.
It's only when you need a very close detection of the rise on the power rail that the zener has an advantage.

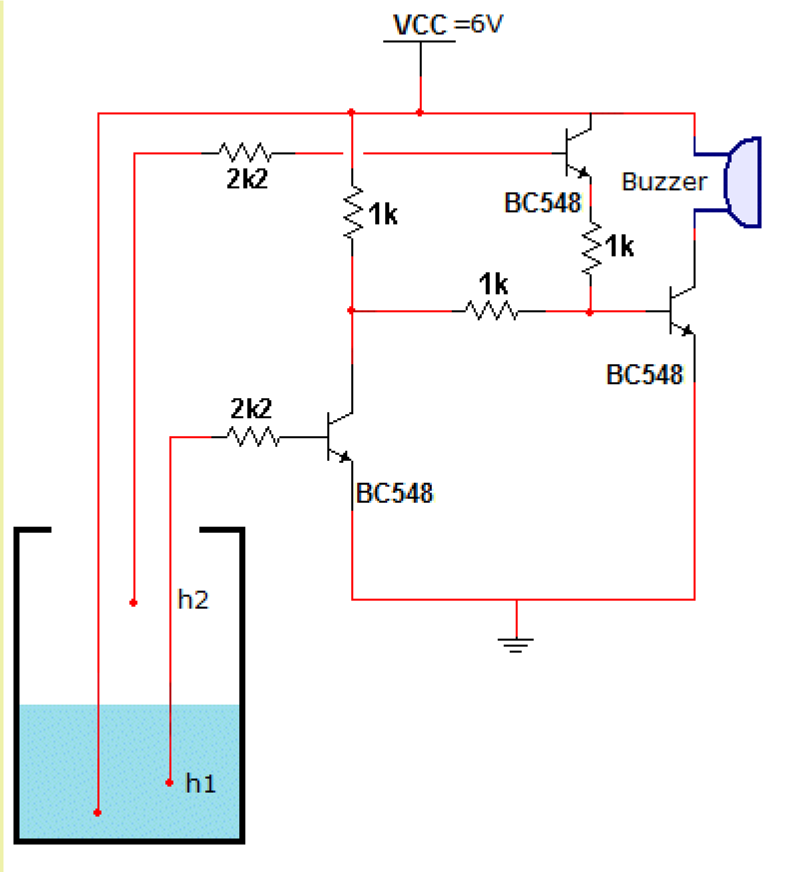
I have mentioned a lot of "ratios" (detection voltage compared to rail voltage rise) and you need to understand how and why this information is important. Email Colin Mitchell and I will write an article on it.
BC187 is a PNP transistor !!
Always use BC547 for a standard NPN transistor as this indicates the cheapest, lowest-voltage, lowest-current transistor can be used.
If you want a higher current, specify BC338. This makes the circuit easy to interpret.
The 1N4007 diode is not needed as the output transistor turns ON and OFF so slowly that the relay does not produce any back EMF.
These are points that show the author of the circuit does not know much about electronics.

HIGH WATER AND LOW WATER ALARM

Here is another circuit from the same INDIAN website. The alarm sounds if the water is low or overflowing.



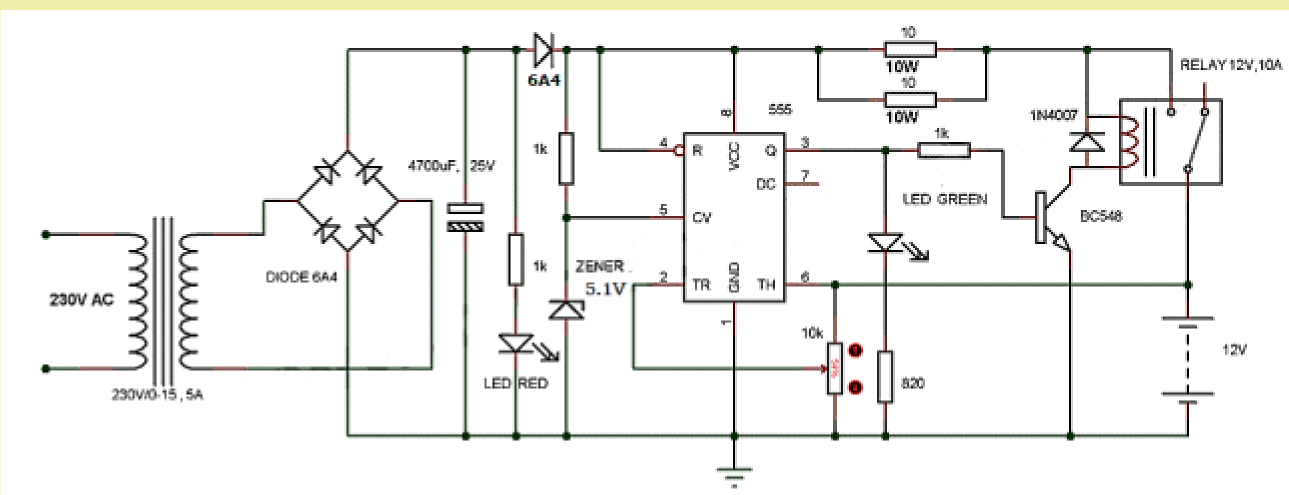
The circuit can be simplified and the OR gate can be removed.
There are lots of ways of including an OR gate without using a digital gate. You can use transistors, diodes or resistors.
The following circuit uses resistors so the output transistor can be driven from two different transistors:



The skill in designing a circuit is to make it as simple as possible, and work out if each component is needed. You don't "add an OR gate" just because the circuit needs a gate. See if you can design around the need for a gate and try diodes or resistors to provide the OR function.

BATTERY CHARGER

Here is another circuit from the same INDIAN website.



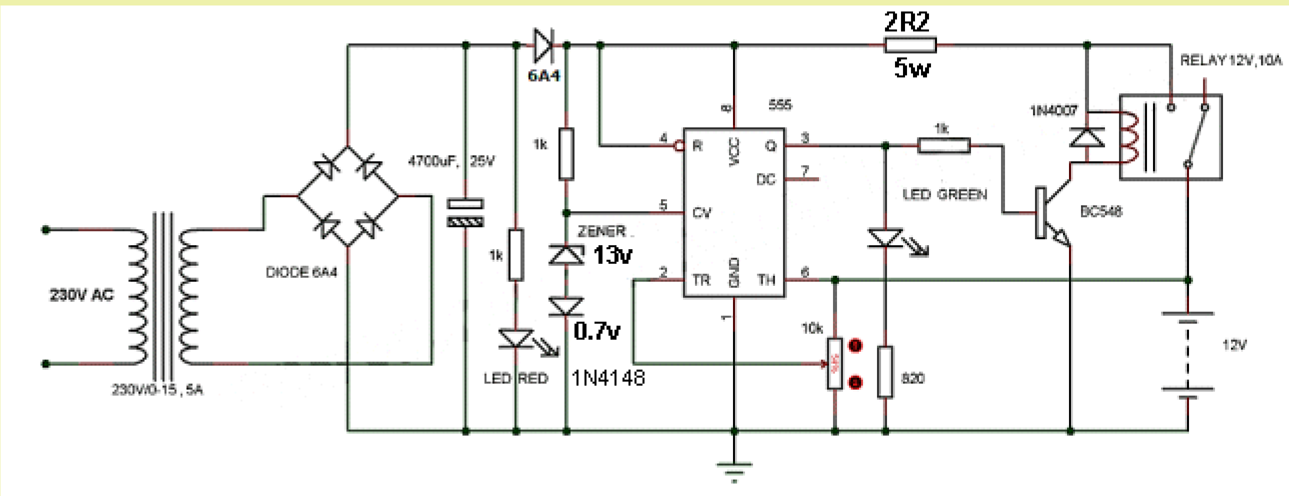
Another, untried, untested faulty design.

The main component of this auto battery charger circuit is a 555 timer which compares the voltage in the battery. It turns ON the charger if the battery voltage is below the variable preset voltage (12 volt chosen here) and turns OFF the charger if the voltage reaches 13.8 volt. The battery charging voltage of the charger can be varied by adjusting the variable resistor.

Pin 5 and 6 are effectively at the same potential via components inside the 555 if nothing is connected to pin 5.
Let's state this a little more accurately.
Pin 5 is at 66% of rail voltage via three 5k resistors inside the chip. If pin 6 rises slightly above this voltage by a few millivolts, the chip effectively "turns OFF." Output pin 3 goes LOW.
Pin 6 can be designed to detect any voltage by "injecting" a particular voltage into pin 5.
The circuit show a 5v1 zener on pin 5, but if this zener is 13v (plus an ordinary diode of 0.7v) the detection voltage for pin 6 can be set at 13.7v.
The 10k pot on pin 6 can then be adjusted to 12v for the lower value to turn the 555 ON.

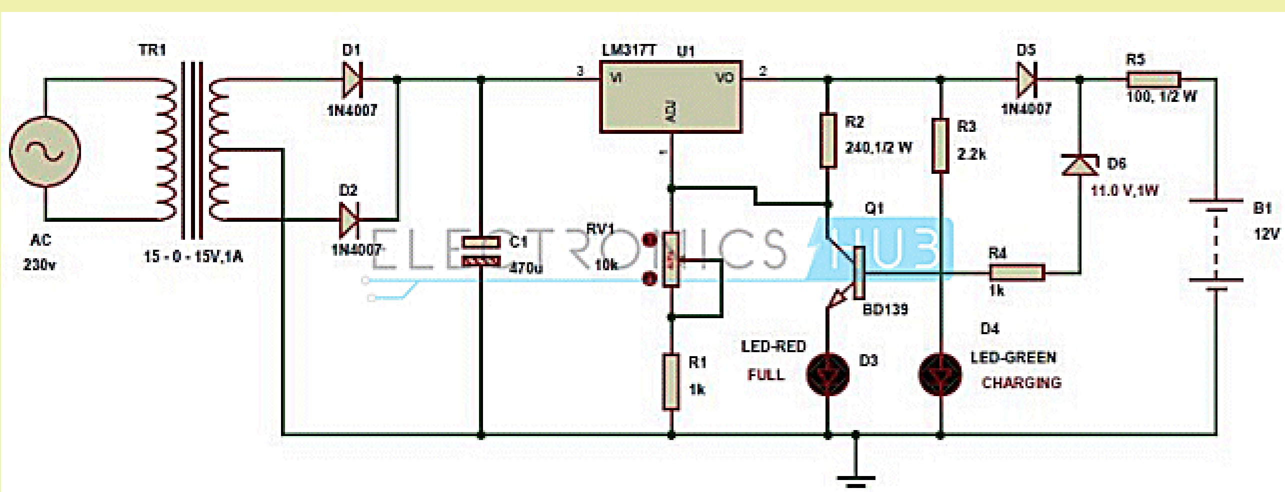
The maximum voltage from the bridge will be about 20v.
The battery voltage will be about 13v. The difference is 7v. As soon as 1.4amps flows through the 10R / 10R the voltage drop will be 7v and it is pointless having a 5 amp transformer and bridge.
This is another circuit that has never been tested.

Here is the corrected circuit:



oooooOOOOOooooo

Here is another battery charger circuit that has never been tested.
The 100R feeding the battery will only allow about 50mA of charge-current. At 50mA, the voltage across the 100R will be 5v and Q1 will already be fully turned ON to reduce the current, so in effect the charge currentt will be less than 50mA !!!!
The 11v zener activates Q1 at about 13.5v and at 50mA the battery only has to rise to 8.5v and the charging current drops below 50mA.

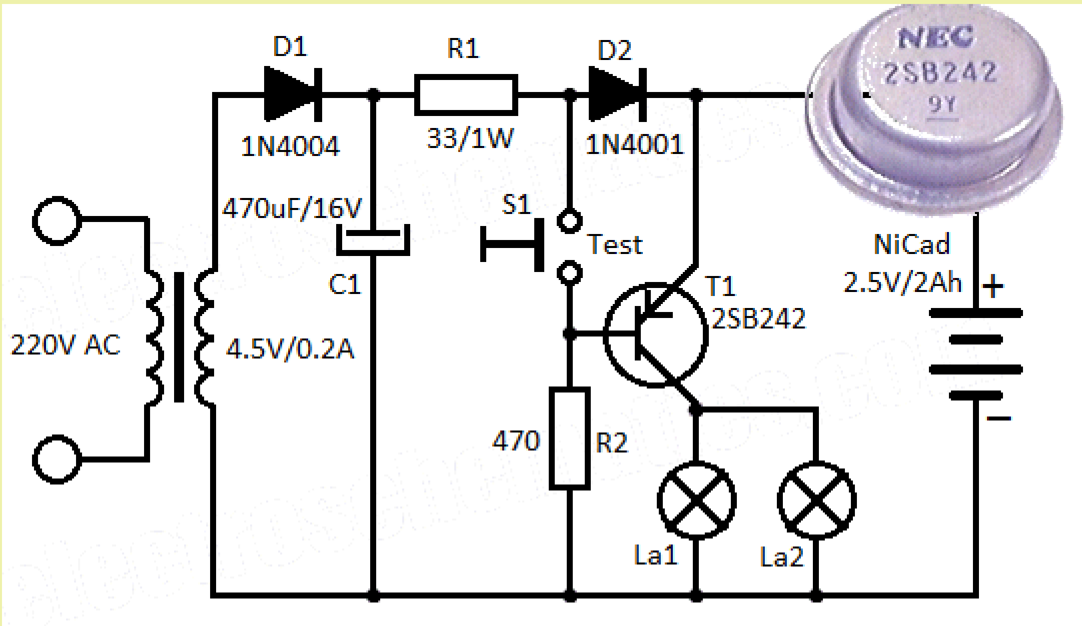


470u in the power supply is going to produce 5v ripple. This means the charger is going to provide pulses to the battery, but that is not a problem.

Replace the 100R with 2R2 or 3R3 and the circuit will charge the battery.

EMERGENCY LAMP

Here is a circuit from an INDIAN website.

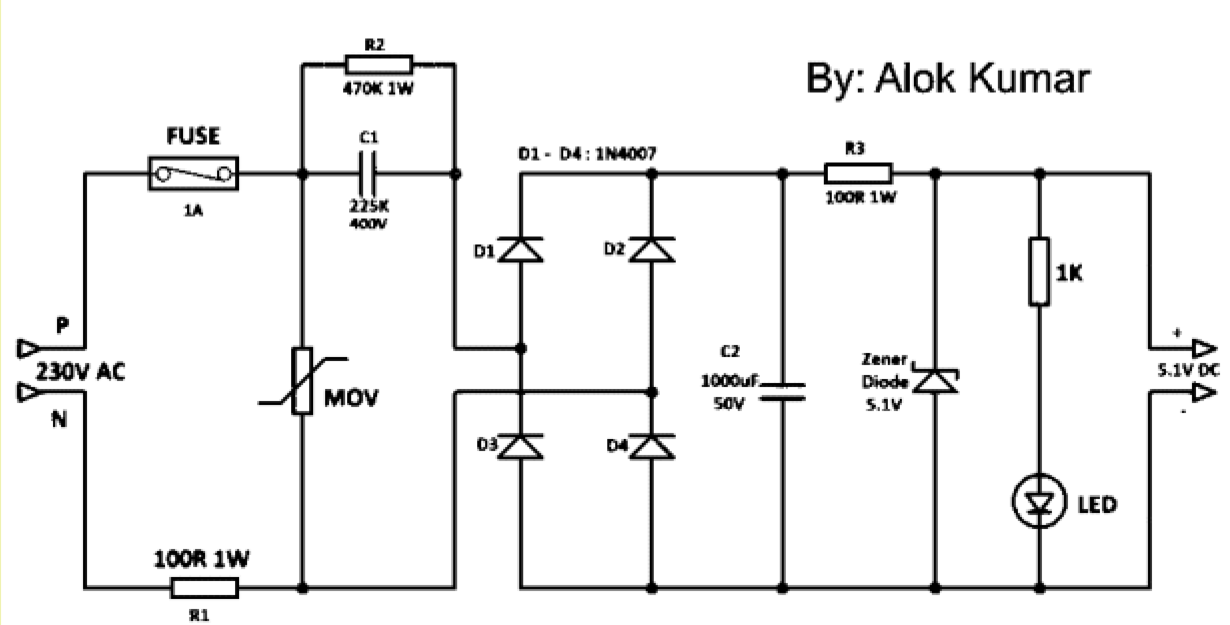


There are so many mistakes with this circuit that it will not work AT ALL.
The two lamps are 2.5v torch globes and each will take about 100mA to 250mA.
The current through the 33R will be 2.5/33 = 75mA MAX.
The circuit is half-wave so the average current will be 75/2 = 38mA (or something near this value as the 470u stores some energy that will increase the average value).
The transistor is turned ON all the time and the globes will take between 200mA and 500mA.
The charging current is 38mA so you can work out how long the 2Ahr battery will last.
The test switch just turns OFF the lamps !!!
D2 is not needed as the battery will not discharge via the secondary winding when the power fail due to the presence of D1.
Why is D1 a 400v diode and D2 a 50v diode ??
2SB242 is a GERMANIUM PNP transistor. Where are you going to get this transistor ??????

I don't know what the author is trying to do but it is obvious the circuit has never been built or tested.
The circuit was taken from Alok Kumar website: https://plus.google.com/+alokkumar-NSIT/posts

POWER SUPPLY

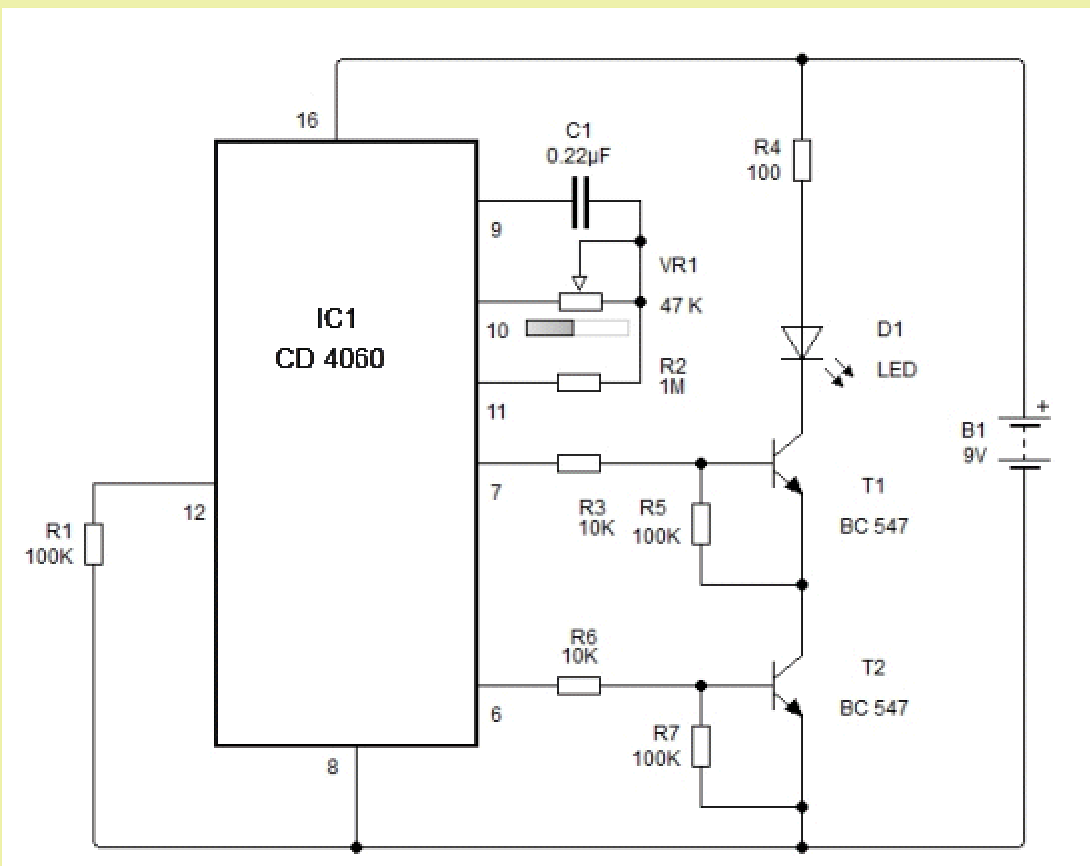
Here is another circuit from Alok Kumar.

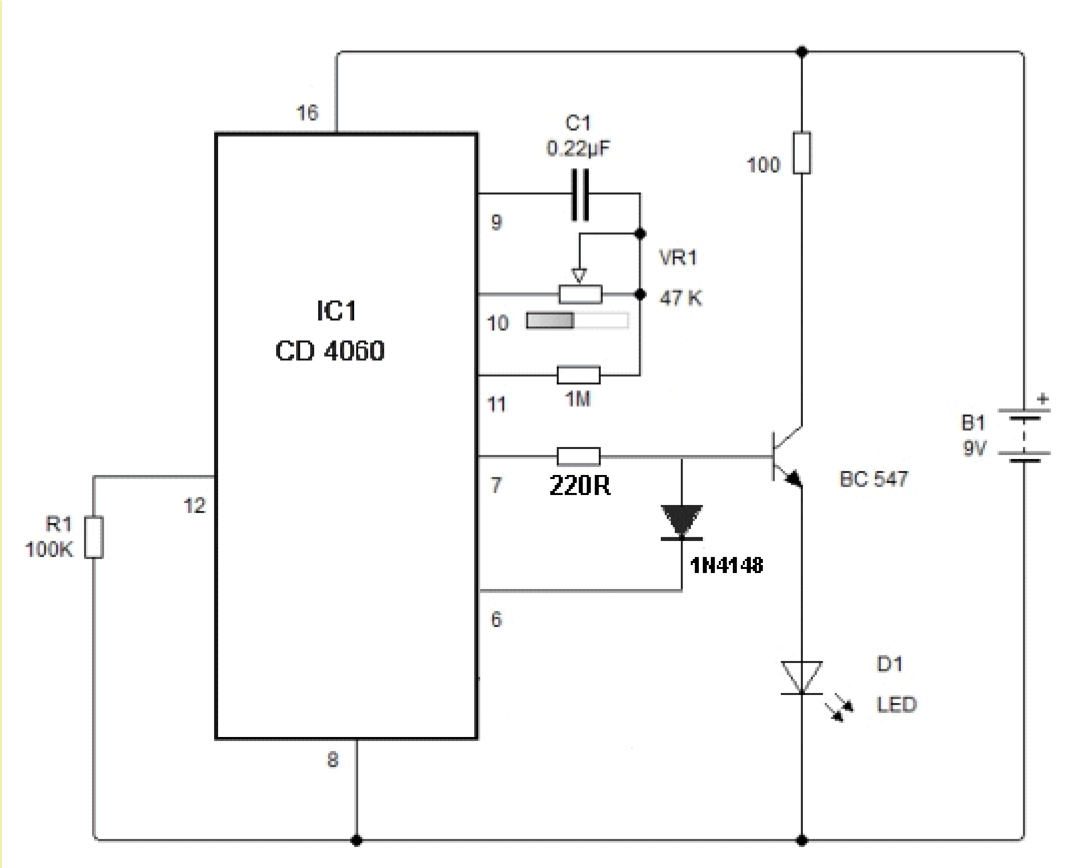


The 225 capacitor will deliver 150mA and the 100R's will dissipate 0.15 x 0.15 x 100 = 2.25 watts.
The 1watt resistors will BURN OUT !!!!
The output will deliver 5v1 and maintain this voltage as long as the current is less than 140mA.
The 1,000u is in the wrong place to have the best effect. It should be after the second 100R, across the 5v1.
The 100R and zener create a REGULATED 5v1 POWER SUPPLY capable of delivering up to 140mA and the voltage will be very smooth with the 1000u across the zener.
The 1,000u WILL have an effect before the 100R, but its effect will be 100 times greater when it is placed across the zener.

LED STROBE LIGHT

Here's a circuit from Professor Mohankumar. He does not know how to produce a simple AND Gate:

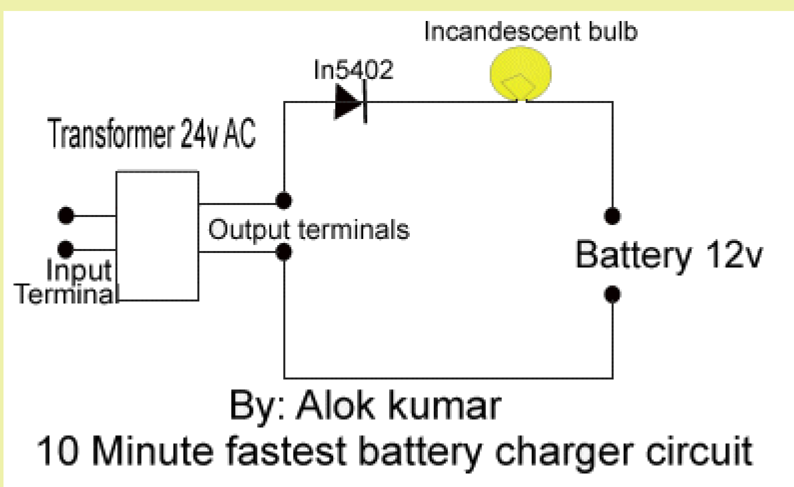




The second circuit shows how to produce a simple AND Gate with a resistor and diode. The transistor only conducts when BOTH lines are HIGH. It uses only half the components and saves a transistor.

BATTERY CHARGER

Here is another circuit from Alok Kumar.



Here is his article. Can you see his mistake?

Components Required:

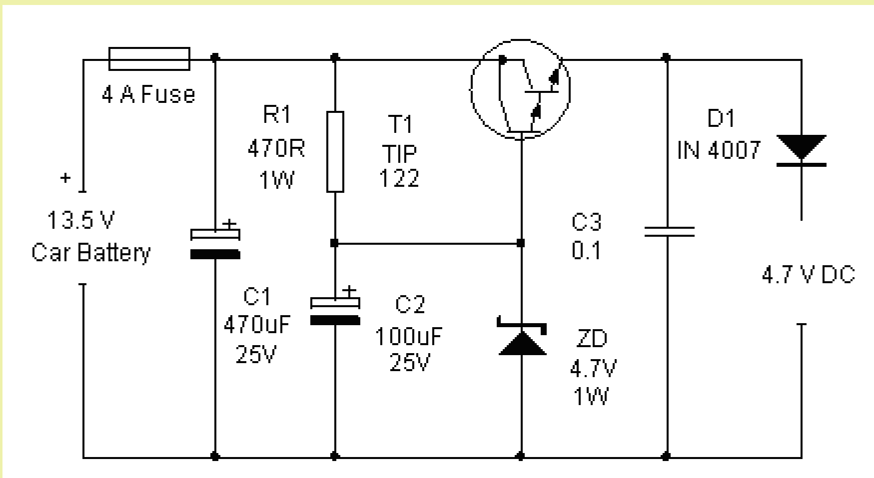
1. One rectifier diode IN5402, or IN5408.
2. One incandescent bulb, having nearly exact voltage rating as the battery but current rating of the bulb should be 1/10 of the value of battery AH (AmpereHour).
3 One transformer having double the voltage rating of the battery. For 12 v battery we need 24v Ac transformer, and current rating of 1/10 of the AH of the battery. For 7AmpHr battery we need 7/10 = 0.7A or 700mA current from transformer.

When we switch on the power, the diode from the transformer will produce half wave 24vdc at output.
The incandescent bulb after the diode acts as a "voltage shocker" or a peak voltage remover. The bulb absorbs the peak voltages and provides an output voltage to the battery.

His BIG mistake is FASTEST BATTERY CHARGER CIRCUIT.
He has used a very small transformer and is using half-wave. It will take at least 14 hours to charge a battery. In 10 minutes the battery will receive very little charge.
The output of the transformer will be over 24 + 12 = 36v and the current delivered to the battery will be fairly high. But this is for each half cycle so the average will be about 700mA. It depends on how the globe reacts to the voltage and current flowing in the circuit.

CAR ADAPTER

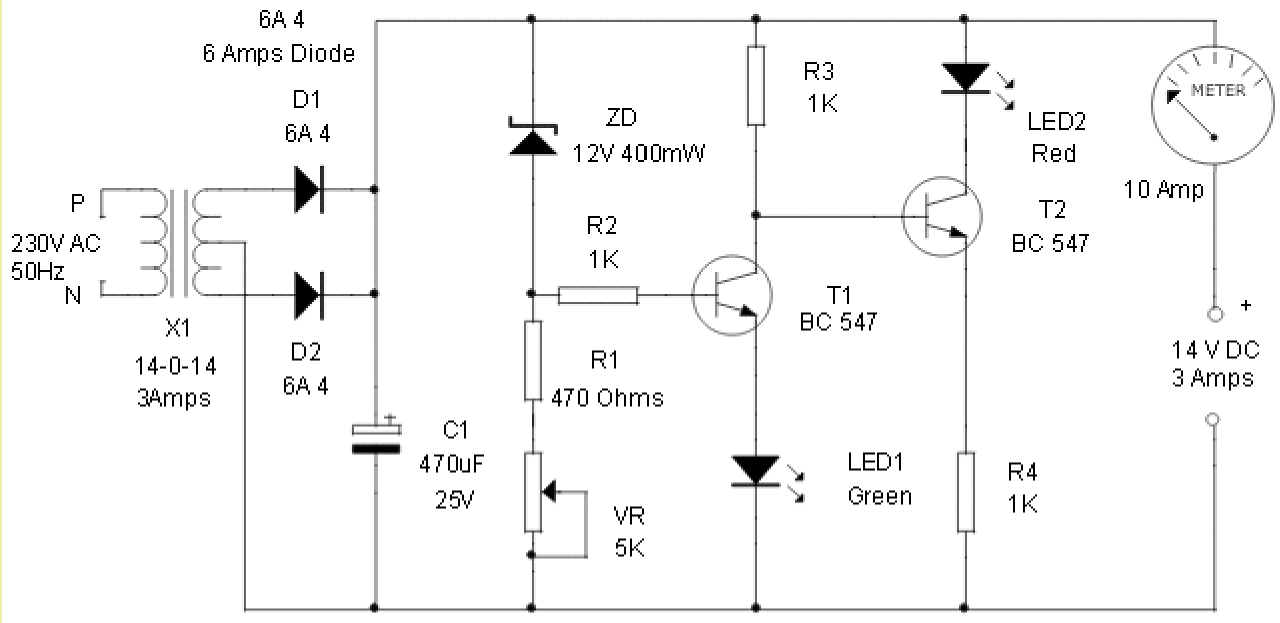
Another circuit from Professor Mohankumar:



The circuit does work if you change a few values.
But the main point of this discussion is to ask: "What is purpose of each component?"
A car battery is very stable as far as ripple is concerned and the 470u will have no effect on filtering any ripple that does enter the project.
Secondly, the Darlington transistor will have an enormous effect on filtering any ripple and will reduce ripple by a factor of more than 1,000.
But the biggest mistake is the 4v7 zener.
The output from the Darlington transistor will be 4.7v -0.7v - 0.7v = 3.3v
This will be further reduce by the last diode to 2.6v !!!!
What is the purpose of D1 ???
D1 is a 1 amp diode but the fuse is 4 amp. The diode will burn out first !!
The 470R and zener produce a regulated supply with up to 17mA of current flowing through the zener.
Suppose we allow up to 10mA into the base of the transistor and the Darlington has a gain of 1,000, this represents up to 10 amps output.
This means the 1000u electrolytic is not needed.
The 4v7 zener can be 400mW and 470R can be 250mW.
The 0.1 on the output is not needed as the transistor does not "self-oscillate" like many regulators.
Thus you can see, nearly every component is incorrectly labeled on the diagram.
It shows how little the Professor knows about electronics.

BATTERY CHARGER

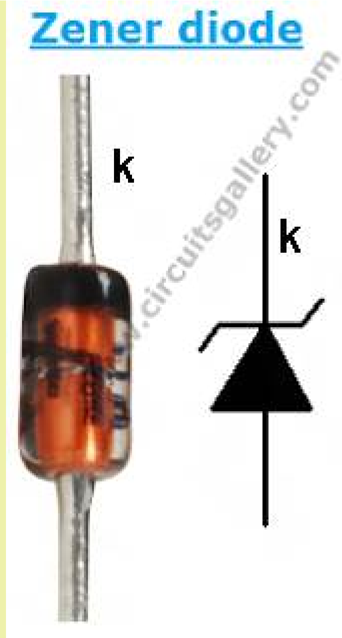
Another circuit from Professor Mohankumar:



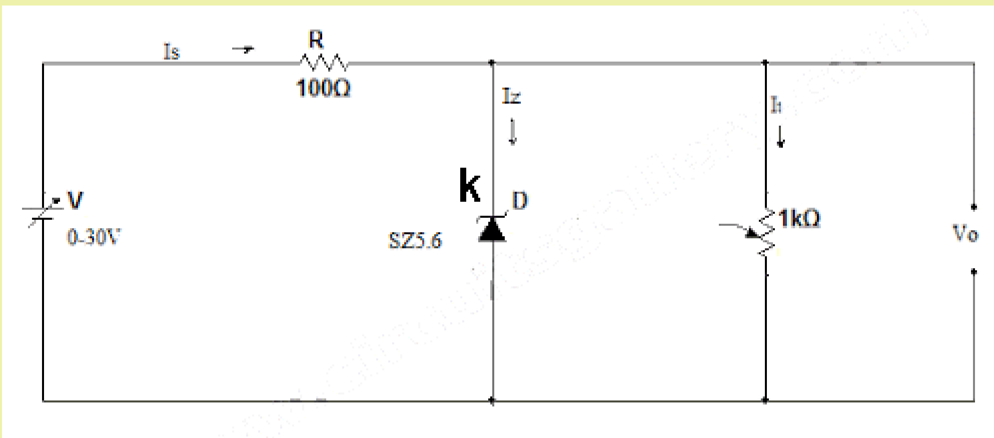
The biggest HIDDEN danger with this type of circuit is this:
YOU CANNOT USE AN ORDINARY TRANSFORMER TO CHARGE A BATTERY.
The transformer has to specially made and labelled **battery charging transformer**.

The reason is very technical. It boils down to the fact that the output voltage has to be EXACT for the current you will be delivering to the battery.
I am not going into the technical details but the winding has to be accurate to HALF A TURN !!!!
If an ammeter is included in the circuit, you need to add half-a-turn !!!
A 14v transformer actually produces 14v AC and when this is rectified, the voltage is 14 x1.4 = 19.6v.
About 1v is lost across the top diode and 18.6v is too high for a 12v car battery.
We do not know anything about the quality of the transformer and if it delivers more than 3 amp when the battery is fully charged, you will have to turn the charger off.
If it delivers more than 3 amp during the charging process, the transformer may burn out.
There is no current-limiting resistor and that's why the circuit must be used with caution.
The 470u has no purpose as most battery chargers use the pulsating DC to remove the sulphate deposits.
Sulphate deposits are high resistance and the peak voltage can sometimes penetrate them and remove them or convert them.

THE ZENER DIODE



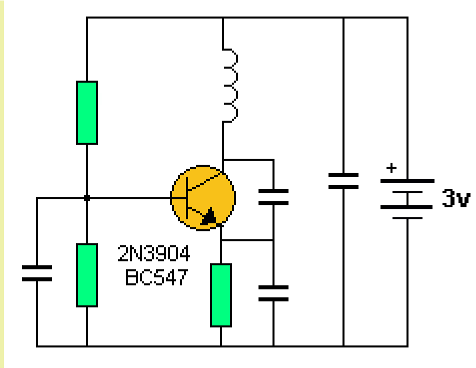
Do NOT use "+"and "-" to identify a zener. ONLY use the letter "k"



Do not label a zener diode with "+"and "-" because it is very confusing and totally inaccurate and incorrect.
Only use the letter "k" for cathode.
I know some readers think that one end is more positive than the other when the diode is placed in a rectifying situation, but that reasoning certainly does not apply in this circuit.
As you can see in the circuit above, the zener does not see "+" on the lower lead, so "+"and "-" is not helpful - it is just CONFUSING !!!!!!

98MHz OSCILLATOR

This discussion has been taken from an electronics forum where a student has asked for component values for the following 98MHz FM oscillator.



My first comment was this:
You really need a cap across the coil to make a reliable osc.

The answer I got from a technician was:
The effective capacitor across the coil is the one from collector to emitter.

And another answer:
Of course, there is a cap in parallel to the inductor.
As a consequence, we have a tuned circuit, which determines the oscillator frequency.

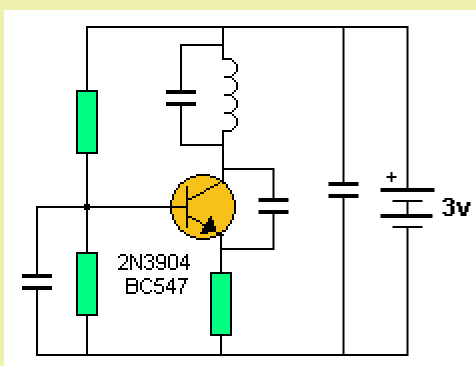
And a third reply:
The two capacitors are across the inductor with the battery in series.

I made some comments about turning the transistor ON and OFF and get this reply:
I think, it is not appropriate for this circuit to think in "ON" and "OFF" terms. The circuit produces a sinusoidal output!

Then we have another comment:
The tuned circuit will have a Q value of maybe 100, in other words, the circulating current will be much higher than the input current, this will be built up over several cycles.

Let's look at these comments and see how incorrect they are.

Firstly we need to look at the circuit and see if it oscillates.

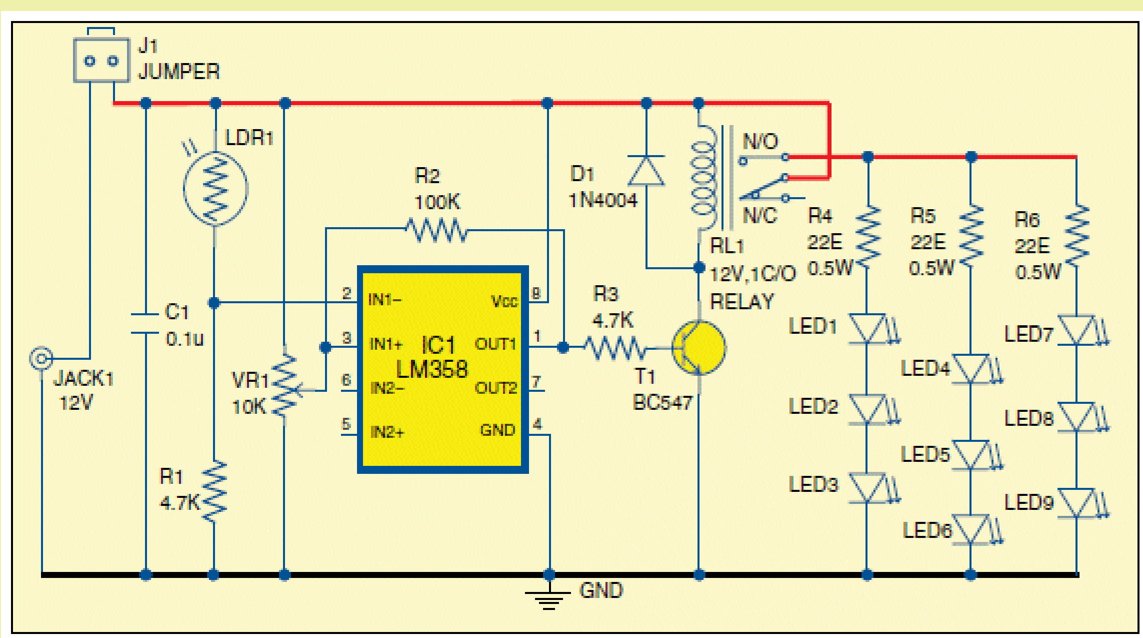


The circuit above oscillates. It has a coil and capacitor connected in parallel to make a circuit called a TUNED CIRCUIT.
This type of circuit produces a sinewave when connected to a power supply and then instantly removed.
It does not need any other components and it does not need a transistor to produce this effect.
So, what do all the surrounding components do?
They connect the TUNED CIRCUIT to the supply and quickly remove it.
It must be quickly removed, otherwise the voltage produced by the TANK CIRCUIT will be reduced. In other words the surrounding circuitry will put a load on the TANK CIRCUIT.
That means the transistor must be turned on and then turned OFF very quickly.
This clears up the faulty thinking of one the replies above.
Now we come to the amplitude of the waveform produced by the TANK CIRCUIT.
We are going to remove all the surrounding components and talk about the TANK CIRCUIT.
For a correctly designed tank circuit, the energy stored in the coil is equal to the energy stored in the capacitor.

This is necessary because the TANK CIRCUIT produces a waveform consisting of half a cycle that is below the power rail and half a cycle that is higher than the power rail.
For both these half-cycles to be identical, the component values must match.
The full amplitude (called the peak-to-peak value) will be the addition of these two values.
Q-values have nothing to do with current. They are a voltage-determined value.
You can now see the first circuit does not have a capacitor across the coil and even though some of the cycle may be produced by the surrounding components, the equal parts of the waveform cannot be produced.
We have not described how the TANK CIRCUIT produces a waveform above AND below the power rail.
The easiest way is to remove all the surrounding components and tap the TANK CIRCUIT across the battery.
This will put energy into the uncharged capacitor and it will be charged to 3v. During this time the voltage will appear across the coil and it will produce a small amount of flux that will oppose the voltage and thus very little current will flow into the coil.
We are delivering energy to the circuit for a very short period of time and this is too short for the coil.
Now the supply is removed and the energy from the capacitor is slowly fed to the coil and it produces magnetic flux. The coil does not accept energy any faster than a certain rate because the "applied voltage" - the voltage on the capacitor, produces magnetic flux called EXPANDING FLUX and this cuts the turns of the coil to produce a voltage in the opposite direction to OPPOSE the incoming voltage and that's why the capacitor discharges slowly.
So far we are producing the lower part of the waveform because the bottom plate of the capacitor is at 0v and the capacitor is gradually discharging.
The capacitor continues to deliver current until a point is reached where the coil is producing a "back voltage" equal to the capacitor and suddenly the capacitor cannot deliver any current.
The magnetic flux in the air surrounding the coil cannot be maintained and it collapses. This produces a voltage in the turns of the coil that is in the OPPOSITE DIRECTION.
We not have a situation where the voltage produced by the coil is OPPOSITE to the previous voltage and as the magnetic flux collapses it delivers a voltage to charge the capacitor in the opposite direction.
Since the two components are equally matched in "energy storage" capability, the capacitor is charged to a voltage EQUAL to the original voltage (but in the opposite direction).
Now you can see how the waveform rises to the voltage of the supply rail when the capacitor has no charge and then rises ABOVE rail voltage as the capacitor charges in the opposite direction.
This exchange could continue FOREVER but there are some losses with the magnetic flux and each cycle becomes smaller and smaller.
If we have a transistor that delivers a small amount of energy at exactly the right time during each cycle, the full waveform will be maintained. That is what the transistor and surrounding components do.
For a 3v supply, the peak-to-peak value of the waveform will be 6v.
The "Q" of the circuit is 2. Not 100.

BACK LIGHT CONTROLLER

Here's another design from: T.K. HAREENDRAN



T.K. HAREENDRAN keeps emailing me about the mistakes on these pages and hates to be criticised.
He claims to be a Professional Circuit Designer and "knows what he is doing."
Here is a sample of his circuitry from **Electronics For You** December 2015.
Look at the 22R resistors.
If you refer to 30 LED Projects you will see an article on the importance of providing HEAD ROOM for any string of LEDs.
Head Room is the voltage dropped (lost) in the current-limiting resistor so that it "matches" the voltage across the LEDs and the supply voltage **to allow LEDs with slightly different characteristics to be used**.
Every LED creates a voltage across its leads when it is illuminated. This can be as low as 1.7v or as high as 3.6v, depending on the colour. This is called CHARACTERISTIC VOLTAGE and varies very little if the LED is small, medium or large. But it can change by as much as 0.4v for white or blue LEDs.
But when you are connecting any number of LEDs to ANY supply, you need to know the exact voltage that will appear across the LED when it is illuminated.
This is easy to do. Just add a 100R or 470R and connect to 6v to 12v measure the voltage across the LED.
In a batch of LEDs, the voltage will vary from 3.4v to 3.6v and if 3 LEDs are connected in series, this will make a difference of up to 0.6v for 3 LEDs.
The voltage for 3 LEDs can be from 10.2v to 10.8v.
If we have 3 x 3.4v on a 12vsupply, the voltage across the 22R will be 1.8v and the current will be 80mA.
But if the voltage of the LEDs is 3 x 3.6v, the current will be 55mA.
The author says the circuit can work with 3.4V/80mA, 10mm white LEDs or with 8mm blue LEDs.
The data sheet states the 10mm white LEDs can be 3v to 3.4v. If 3 x 3v LEDs are used, the current through the 22R will be (12 - 9 = 3v) 3/22 = 136mA.
You can see the current will vary from 55mA to 136mA, depending on the characteristic voltage of the LED and unless you test each LED very accurately before using the circuit, they will be DAMAGED.
On top of this, the 12v must be an accurate 12v supply as an increase of 1v will will also damage the LEDs.
The idea of the CURRENT LIMIT resistor is to provide safety (prevent over-current) for the complete range of possibilities that may occur - including voltage rise.
22R only allows a range of 1.8v and this can be swamped by the supply increasing by 1v and selecting a set of low CHARACTERISTIC VOLTAGE LEDs.
Using 3 LEDs does not allow very much HEAD ROOM and only 2 LEDs should be used, unless you have accurately measured the voltages, and the supply does not rise.
You can also get 10mm white LEDs that require 25mA max for 20,000mcd, (10 cents each on eBay) so some LEDs are much more efficient than others and much cheaper.
The other bad feature of the circuit is the rectangle for the LM358. It should be drawn as an op-amp (a triangle) so you can instantly see what is happening in the circuit.

DOOR ALARM

Here is another junk circuit from Electronics For You magazine August 2015.
It is a **Door Alarm** using a HALL EFFECT device.

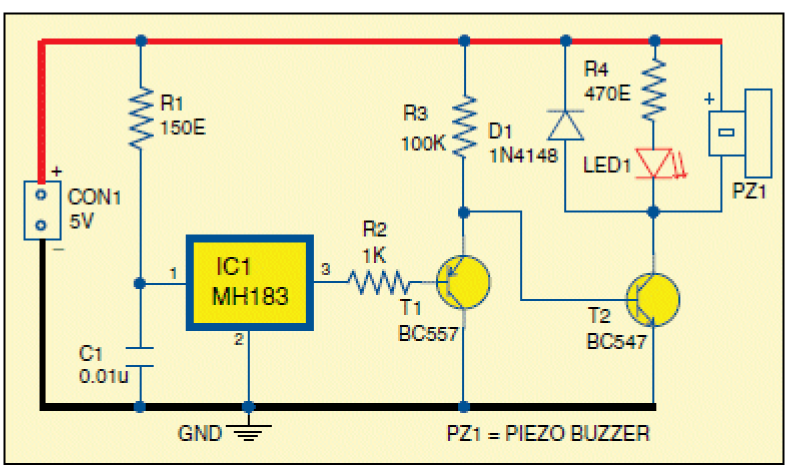


Fig. 1: Circuit diagram of the door-opening alarm

The circuit DOES NOT WORK.
If the output of IC1 goes to 0v, the emitter of T1 will be 0.6v due to the base-emitter voltage of the BC557 transistor. The output transistor will be turned ON **all the time**.
I can see this fault instantly. No-one in the technical department of EFY picked up the mistake and published it to

their 40,000 readers. Every issue of the magazine has mistakes like this.
And they told me I could not "spot a mistake" in their magazine !!!
You don't need a complex circuit like this. Just a reed switch and a magnet !!!

BATTERY CHARGER

Here is another junk circuit from **Electronics For You** magazine August 2015.
It is a BATTERY CHARGER.

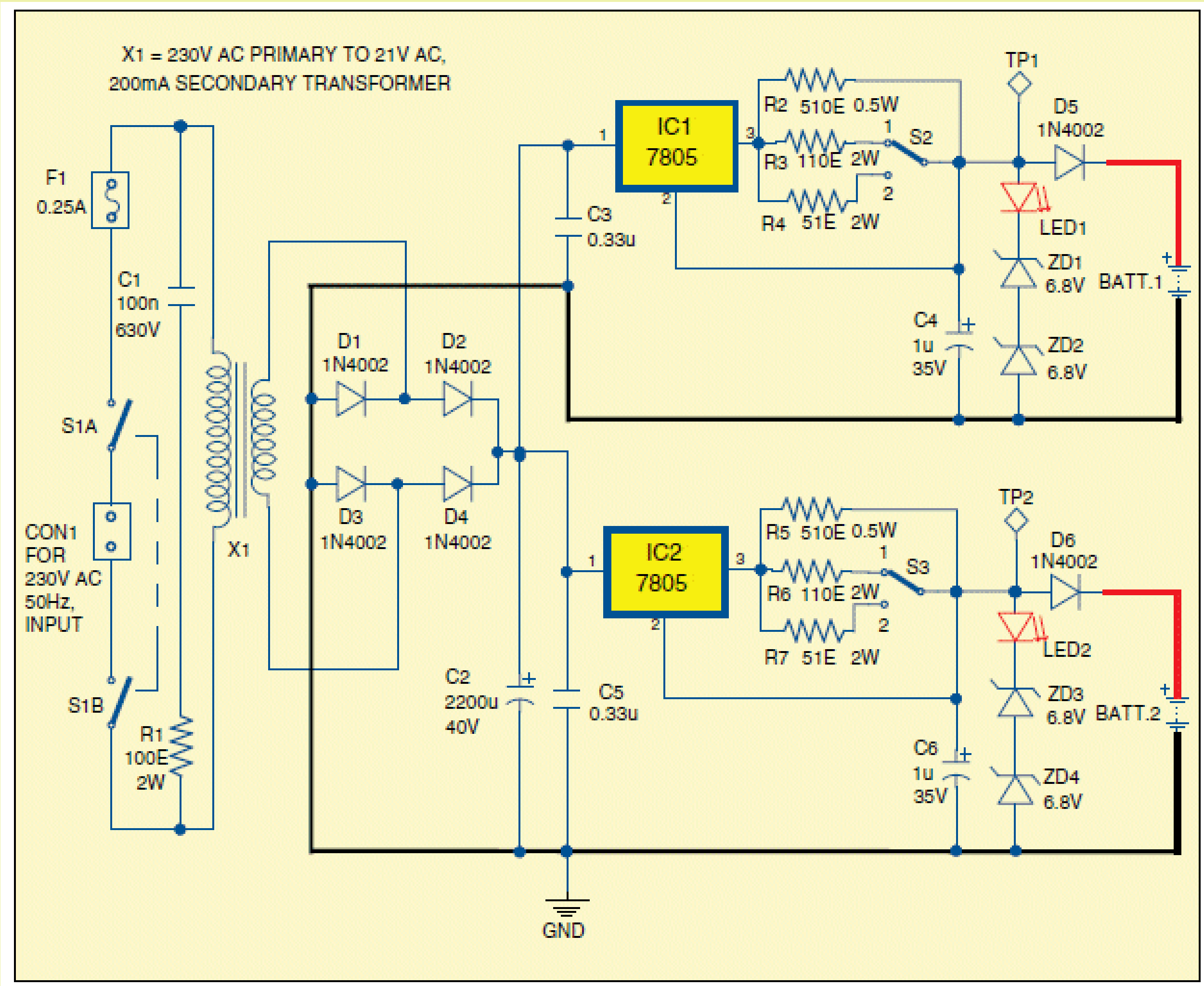


Fig. 1: Circuit of the simple device maintaining two 12V rechargeable batteries

Why include a 7805 regulator when the 51R resistor will limit the current to (30v - 14v = 16v) 16/51= 300mA or 30mA with the 510R resistor (with the 7805 removed).
The 7805 simply maintains the current at 300mA. **WHO CARES ?????**
The 2,200u is not needed and the 7805 is not needed. Another over-designed circuit from **Electronics For You,** making them look stupid.

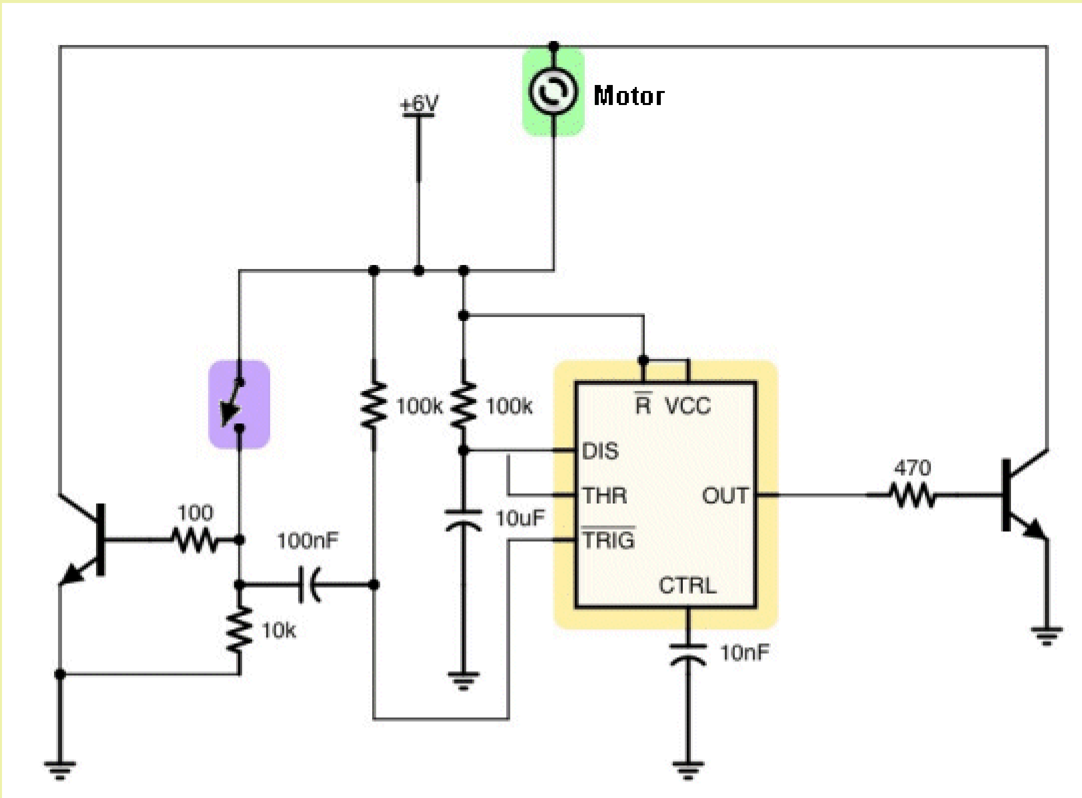
FUSIBLE RESISTOR

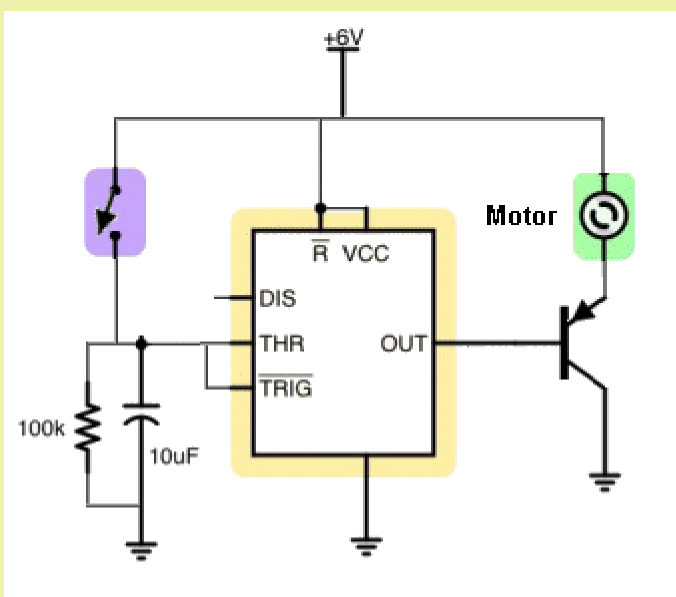
A resistor can be used as a FUSE, but it has one big problem. It creates a voltage-drop across it and this means the supply rail needs extra electrolytics to provide "stability."
One reader wants to replace an 82 ohm 0.5watt FUSIBLE RESISTOR.
An 82 ohm resistor will pass a current of 80mA and produce a voltage drop of about 6v6 and stay warm for years, dissipating 0.5 watts of heat.
The current needs to rise by at least 50% for the resistor to start to fail and in most cases it will fall off the board before it changes resistance or the leads will create a dry joint.
When the current increases by 50% (120mA) the wattage (heat) generated will be over 1 watt and the resistor will fail.
However it will go up in smoke if a short-circuit occurs and then you will have to find the shorted component.

If the resistor is replaced by 82R 0.75watt, it will take about 1.5watt to burn out and this will be about 140mA and the voltage across it will be about 10v to 12v.
A 0.75 watt can create a lot of heat and fire if burning out slowly, so it must be covered with fibre-glass tubing and kept away from the PC board and all other components.

MOTOR CONTROL

Here is a circuit that can be simplified:





The motor continues to operate about 2 seconds after the switch is opened, until the 10u drops below 33% of rail voltage, as is discharged via the 100k.
I have mentioned it before. When designing a circuit, see if the design can be simplified, as someone will always come up with a simpler design. That's the skill in designing a circuit. And that's the skill we are showing you in these articles.
We are beyond any text book or university course. We show you more than just being able to design a circuit.

We show you how to simply it and improve it.
There are lots of businesses that have gone broke when a competitor has brought out a cheaper and simpler design. The Garrard turntable, tape recorder, video recorder, transistor radio, TV and lots of mechanical devices.
It takes a very clever person to see a device and say: "I can simplify this!"

Here's some mistakes from **Electronics For You** Magazine January 2016:

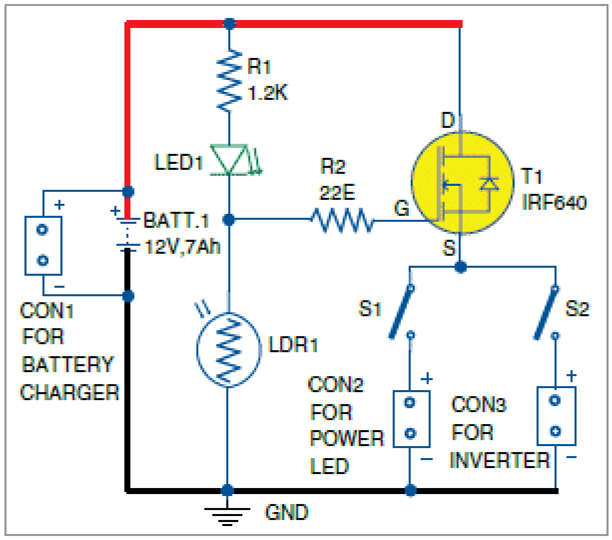


Fig. 2: Circuit diagram of the dusk-dawn controller

The FET is in FOLLOWER MODE and this means the Source rises as the FET turns ON.
But the Gate must be about 2v to 4v HIGHER than the Source for the FET to be fully turned ON.
This means the Source can only rise to 8v to 10v.
The reason for using a FET is the very small voltage dropped across the Drain-Source terminals when it is fully turned ON and that's why it is able to pass a high current.
This is another useless circuit by **Bikash Rai** that has not been checked or tested by the non-existent technical staff at **Electronics For You.**

SOLAR LIGHT

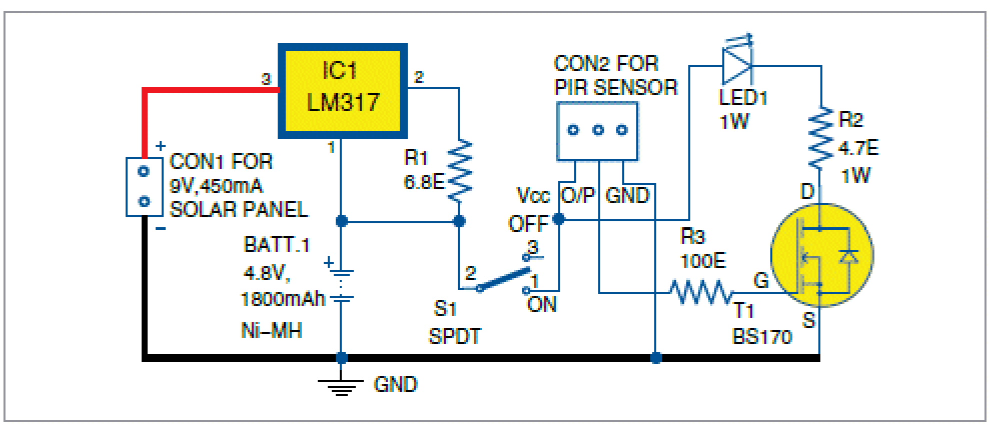
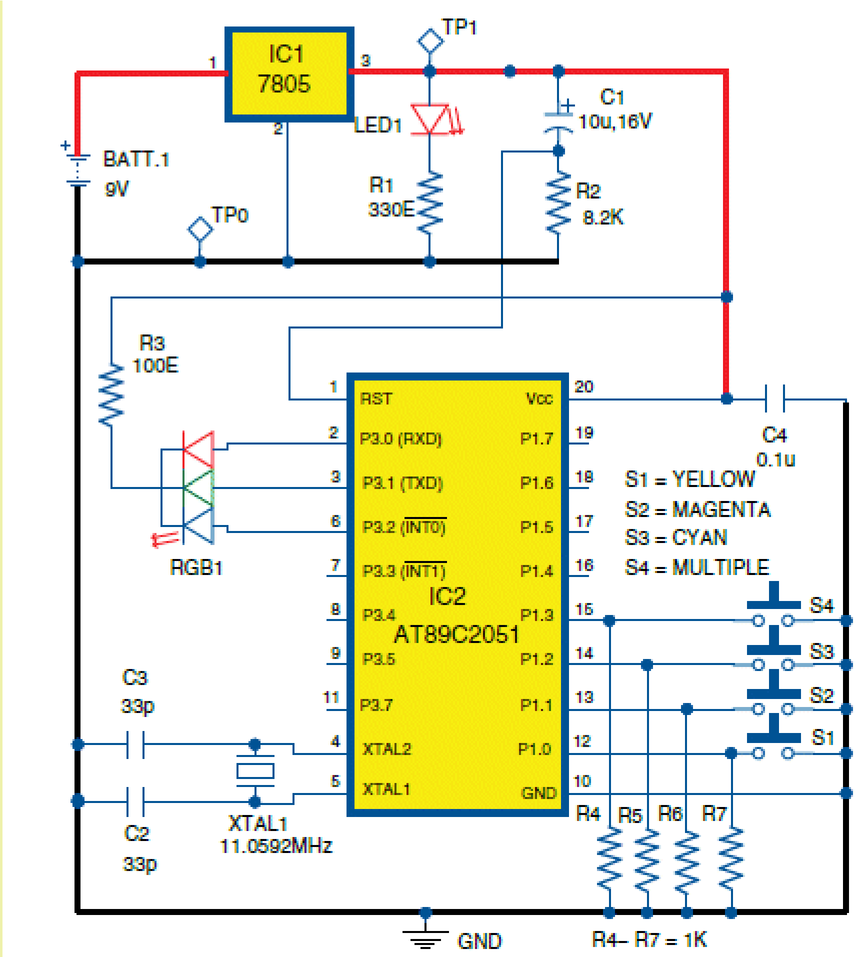


Fig. 2: Circuit diagram of the solar light for a portable toilet

Why use a 450mA solar panel and then limit the charging to 180mA?
Buy a 200mA panel and remove the LM317.

RGB Generator



The problem is the 100R on the tri-coloured LED.
When the red LED is turned ON, pin 2 will be HIGH and the voltage across the LED will be 1.7v.
When the green LED turns ON, it needs 2.1v and only 1.7v is available, so I don't know what will happen.
And when the blue LED turns on too, it requires 2.3v and I have no idea what will happen.
The common cathode of the tri-LED should be connected to 0v and 100R's connected between each of the anodes and the outputs of the chip.
This will allow each colour to be driven correctly.
In other words, the tri-coloured LEDs are around the wrong way !!!

Here is a comment from Andrew:
Have a look at the switches and resistors (R4-R7) on Port 1 pins. Since the AT89c2051 has (approx) 50kohm internal pull-ups on Ports 1 and 3, the Indian 'designer' didn't actually need to add these extra four 1k resistors. However, having done so, he tied them all to ground! If they had been connected to Vcc, the switches could have been read. The way the circuit shows, the resistors are not effective. The port pins are tied to ground via the 1k resistors and the switches connect to ground when pressed. What a mess !!!

PIR MOTION SENSOR

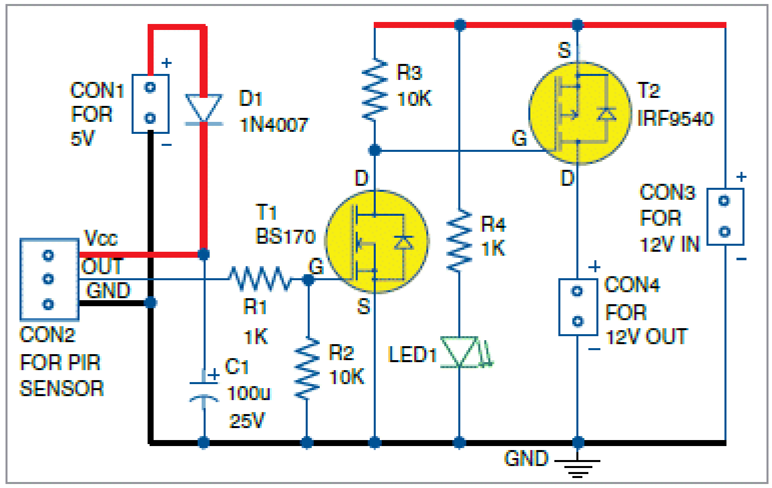
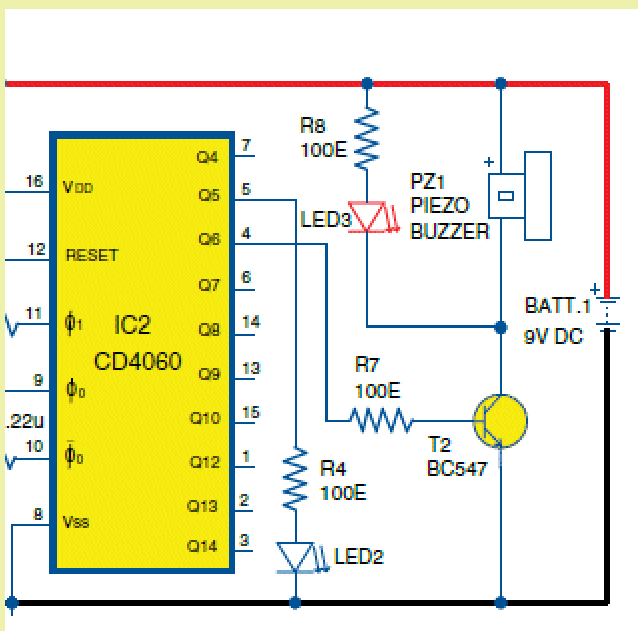


Fig. 2: PIR motion Sensing SSR Switch

Here is another project from T.K. HAREENDRAN.
Here are 4 points to improve this circuit:
1. The PIR module works on 5v to 20v. A separate 5v supply is not needed. The PIR can be connected to the 12v rail.
2. A 1N4007 diode is not needed as the module only consumes 3mA !! Use a signal diode 1N4148.
3. BS 170 costs 70 cents. A BC547 transistor can be used (cost: 10 cents)
4. R1 is not needed.

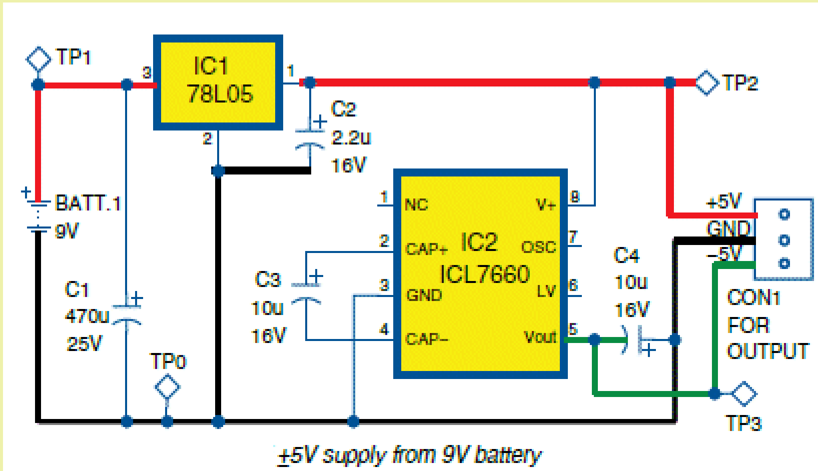
FIRE SENSOR



Here's another poor design from **D. MOHAN KUMAR**. All his circuits are filled with mistakes. He has no idea how to design a circuit.
The CD 4060 IC can deliver about 10mA from each of the outputs. If you try to take more than 10mA, the output does not go fully HIGH but drops to an unknown value while delivering about 10mA (or slightly more).
This puts added strain on the output and shows the author of the circuit is not a good engineer.
In the circuit above, the 100R resistors on the output will try to take 80mA, and this shows the incompetency of the person designing the circuit. A LED only needs 10mA and a transistor only needs a few milliamp.
The output will only deliver about 10mA, but the output voltage will only be a few volts due to the low value of the load resistor.
If this circuit was presented in any magazine, other than one from India, the author would never be allowed to supply another project.

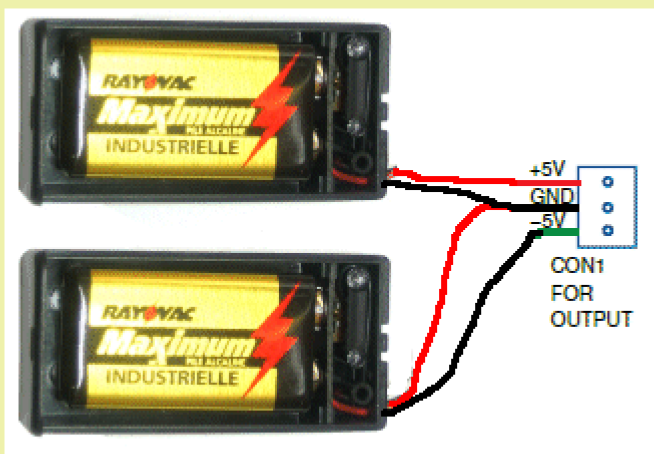
It is obvious **Electronics For You** has no-one to test or check any of the projects and that's why the magazine is filled with RUBBISH like this.

+5v -5v SUPPLY

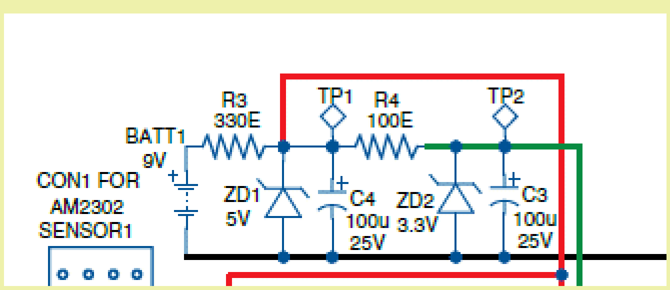


±5V supply from 9V battery

Here is a project to produce 5v and -5v from a 9v battery for an op-amp, or any circuit that needs a split supply.
The simplest way to do this is to use two 9v batteries (or AA cells to produce 6v). The circuit below does not need a switch and is not limited to 50mA per output. It is also much cheaper. This is the art of thinking OUTSIDE THE SQUARE.
It is easy to produce something extravagant and expensive, the skill is to produce something simple and cheap.



3v3 ZENER



Let's look at the zener diodes and the current they can supply.
What happens is this.
The zener diode passes (loses - wastes) a certain amount of current via the load resistor and when you draw current from a ZENER REGULATOR CIRCUIT you actually take (rob) the current from the zener.
The first zener regulator circuit consists of a 5v zener and 330R. The voltage across the 330R will be 4v and the

current through the resistor will be 12mA.
You can only take up to 12mA. If you try to take more than 12mA, the "stable" 5v drops to a lower value.
In other words, the circuit DROPS OUT OF REGULATION.
The second ZENER REGULATOR CIRCUIT is the 3v3 zener and 100R. The voltage across the 100R will be 5v - 3v3 = 1.7v. The current through the 100R will be 17mA.
But we only have 12mA available !!!!
This means the 5v zener regulator circuit will DROP OUT OF REGULATION and the 5v will drop below 5v BEFORE the project is connected to the supply !!!!! The voltage will drop EVEN FURTHER when the circuit is added (connected).
This circuit has obviously NEVER been tested and **SOMNATH BERA** has no idea how to design a circuit.
Just another untried, untested circuit from **Electronics For You.**
This problem can be detected very quickly by simply looking at the component values. It does not need a University professor to sit down for 30 minutes and work out the values. You can do the calculations "in your head" in 30 seconds and that's what I am getting across in these pages.
You have to carry out quick calculations for everything you do, so you don't make a fool of yourself.
Every project in **Electronics For You** has mistakes. I have notified "Chopra" for the past 2 years and he has done nothing to correct the situation.
In fact he has omitted all my corrections in subsequent issues. He only talks about "R1" should be "R2" and other similar nonsense.

CONTROLLER

Here's another mistake from **Electronics For You** Magazine January 2016:

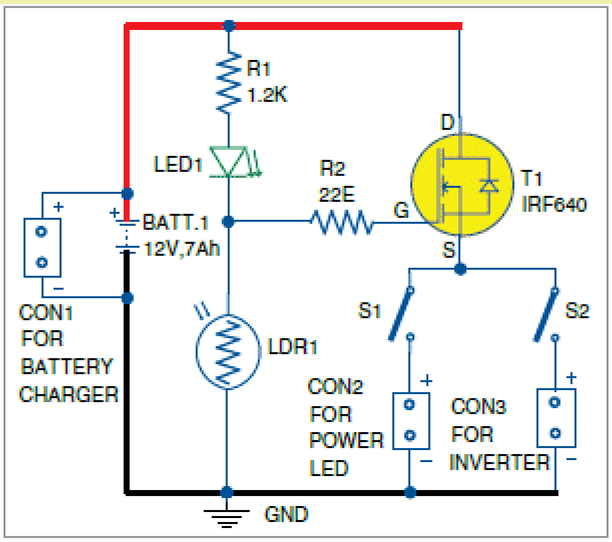
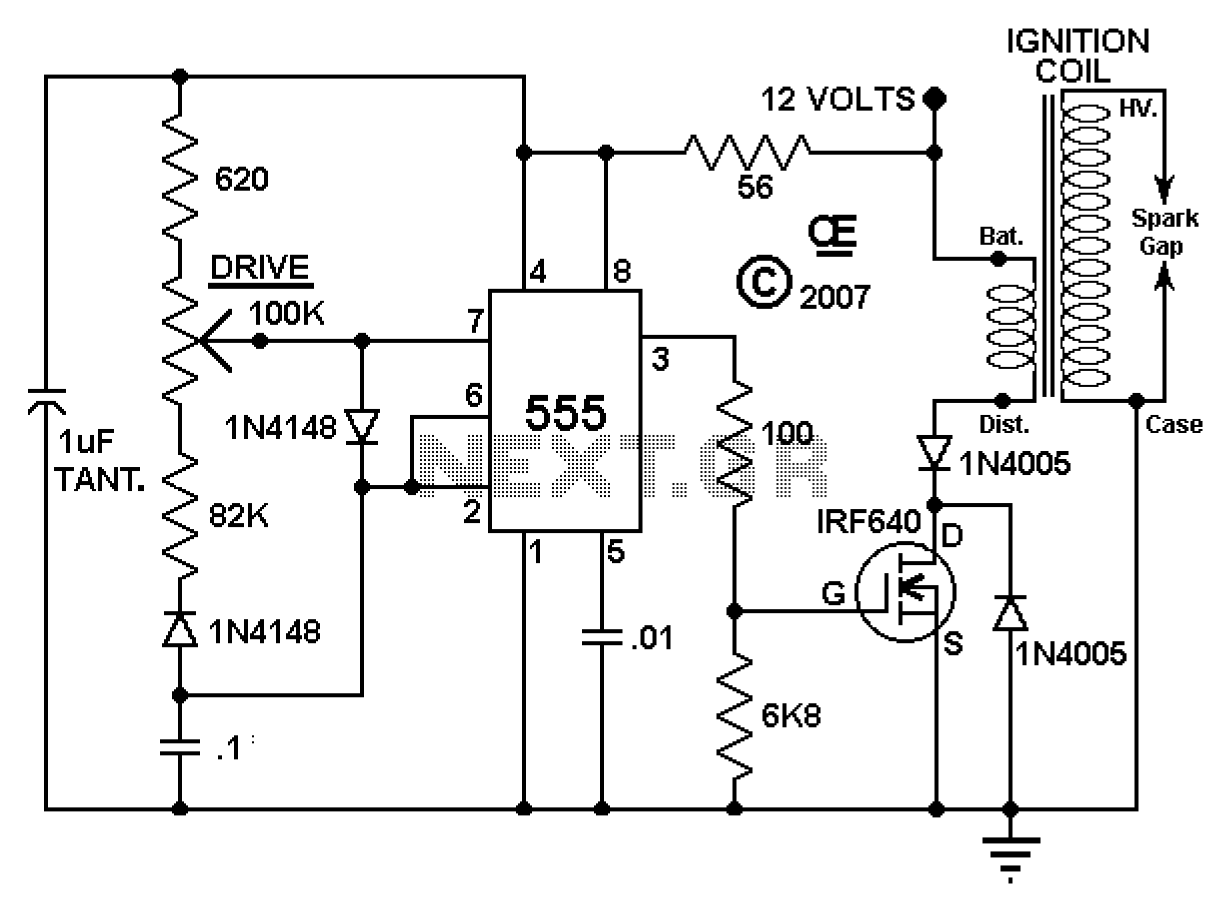
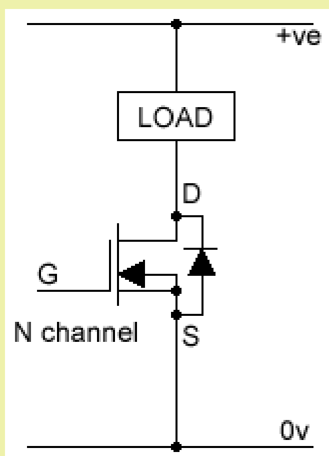


Fig. 2: Circuit diagram of the dusk-dawn controller

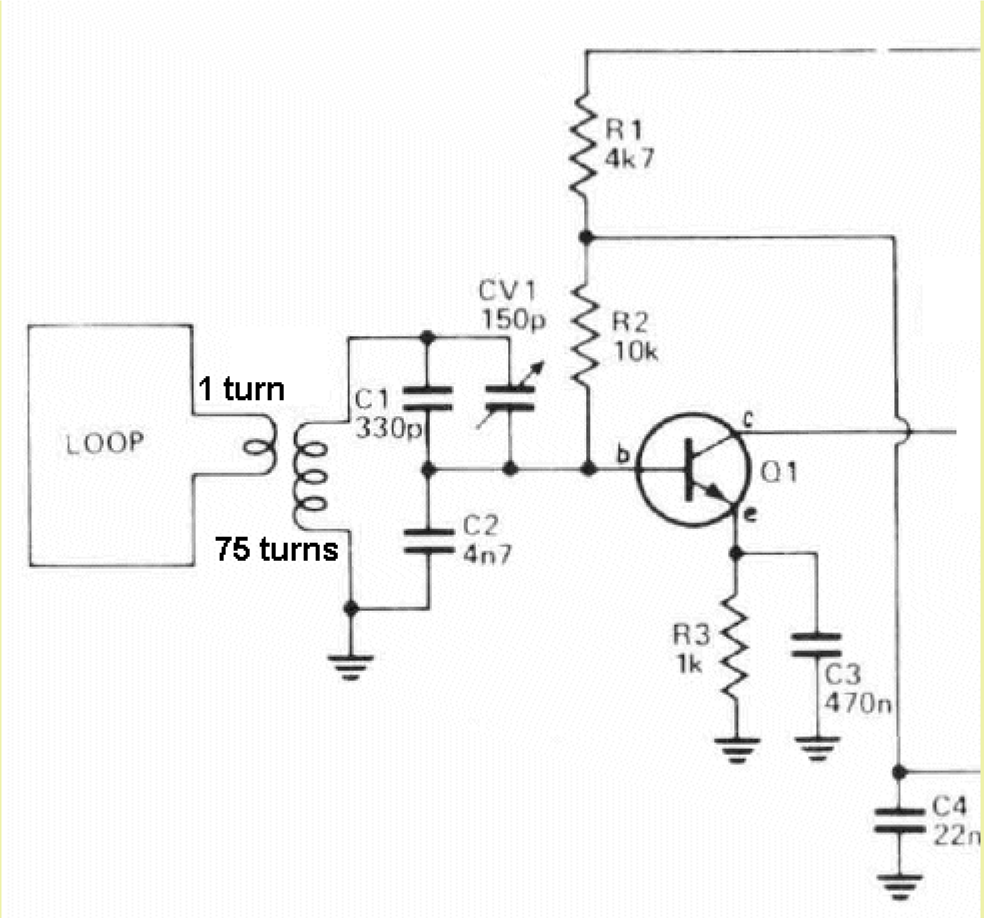
The load should be in the DRAIN. When the GATE is 4v to 10v higher than the SOURCE, the FET turns ON and is finally FULLY TURNED ON.
But since the FET is in FOLLOWER mode, the source rises if the FET turns ON and the voltage on the gate never rises above the voltage on the source.
The following two diagrams show how the FET should be connected in a circuit:





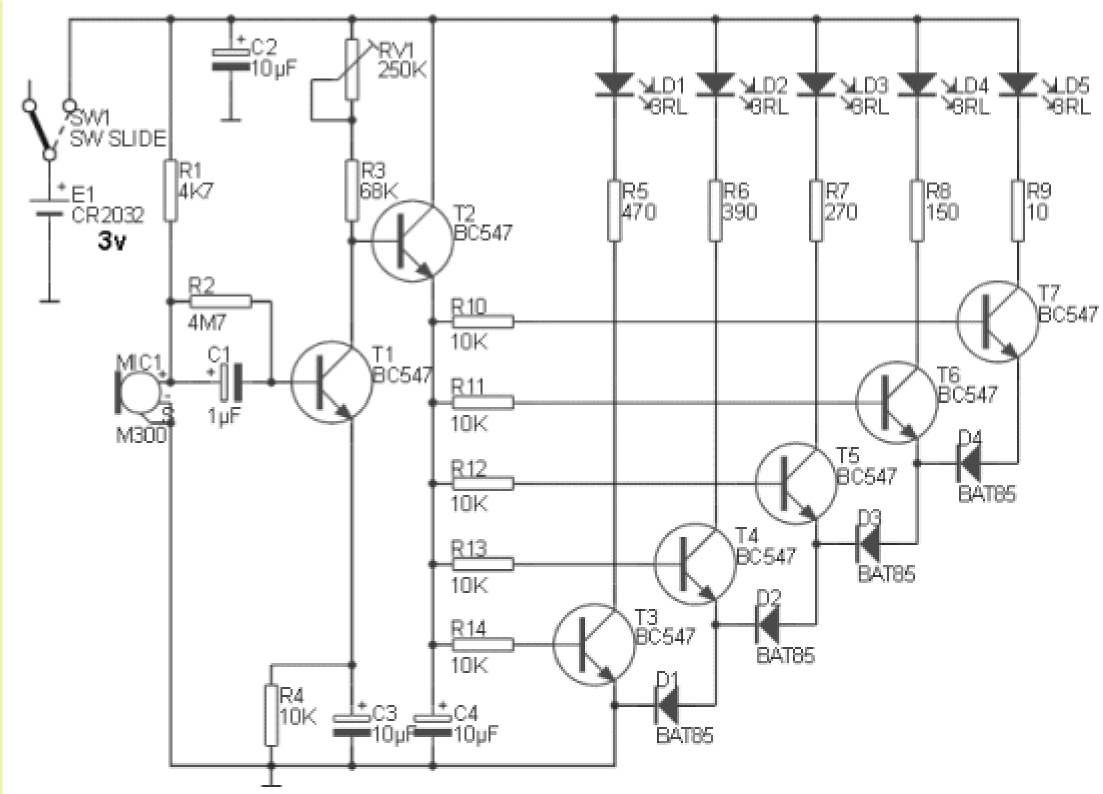
METAL DETECTOR

Here is the front end of a metal detector. The search coil consists of a loop of 1 turn and is fed into a transformer consisting of 1 turn. The other winding is 75 turns.
The circuit was designed by non-electronics personnel and we will explain the problem:



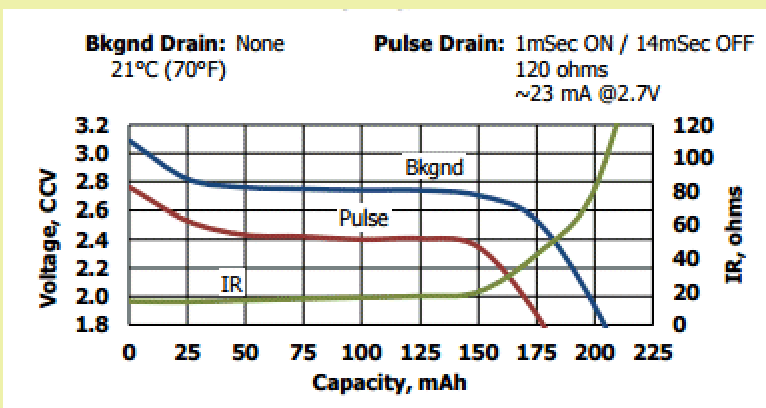
The search coil consists of one turn and when you are picking up very small magnetic fields, the voltage and current produced in the single turn will be very small.
The transformer connected to the loop consists of 1 turn and 75 turns and theoretically the output voltage will be 75 times higher than the voltage generated by the loop.
But the current will be reduced enormously and we all know a transistor is a current-controlled device, and a considerable current is needed to get it to work, especially when 10k is connected to the base.
The circuit will be much more sensitive if more turns are added to the "loop" and the output is connected directly to the transistor.

VU METER



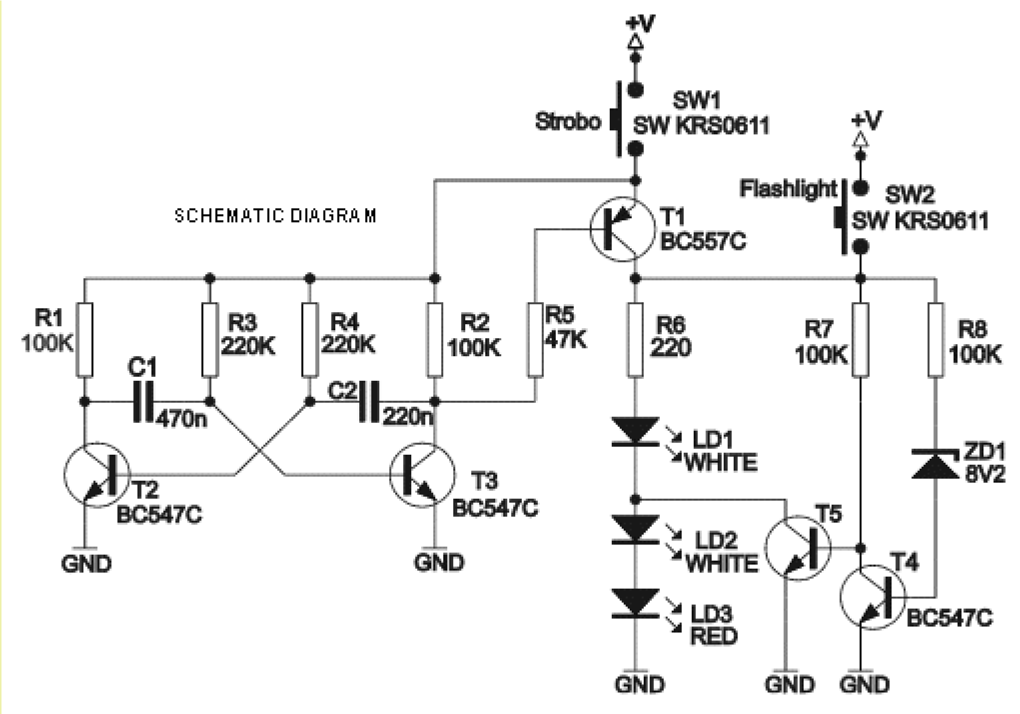
Here is another project from Velleman.

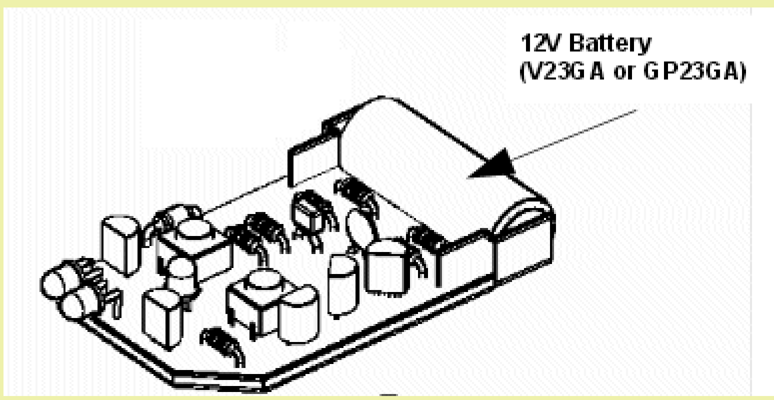
The supply is 3v and the final LED has a voltage drop of 1.7v across it when illuminated. The drop across each diode is 250mV = 1v and the collector-emitter voltage of the final transistor (T7) is 200mV.
This makes a total of 2.9v.
Here is a graph of the voltage when 23mA is flowing:



The supply is 3v
You can see the voltage falls below 3v after a short time and it will be very difficult to illuminate the top 3 LEDs.
The circuit is a very bad design as no allowance has been made for the battery voltage to fall (as the battery get older).

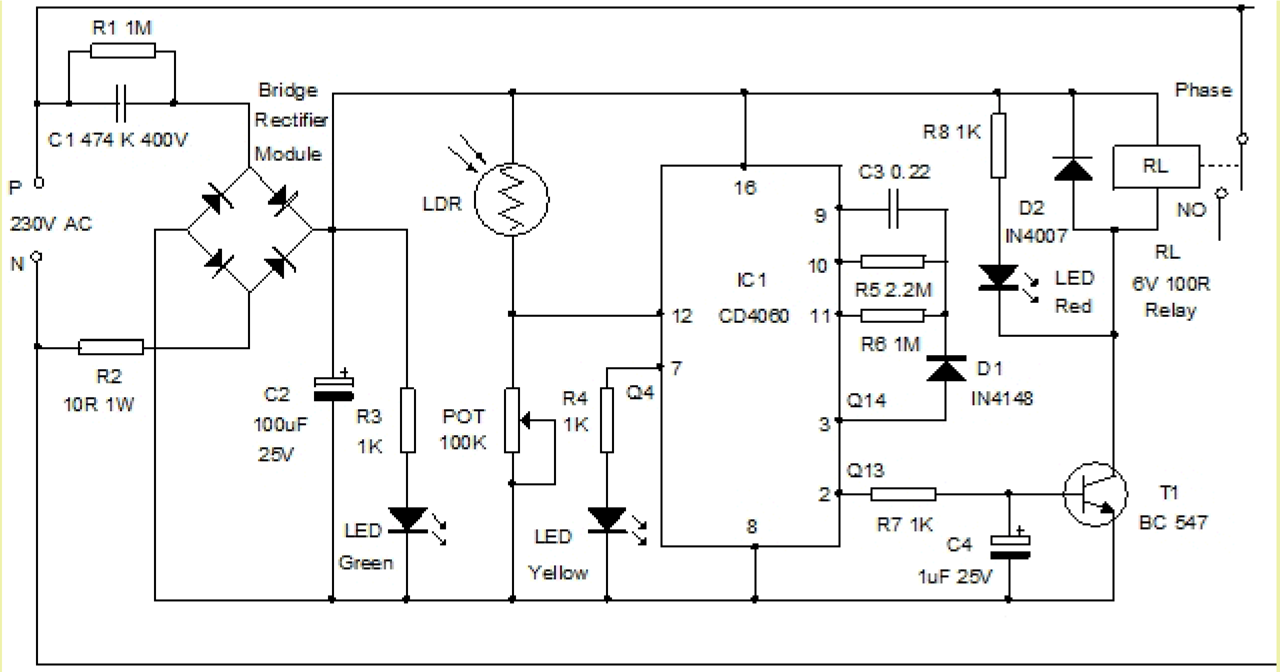
LED TORCH





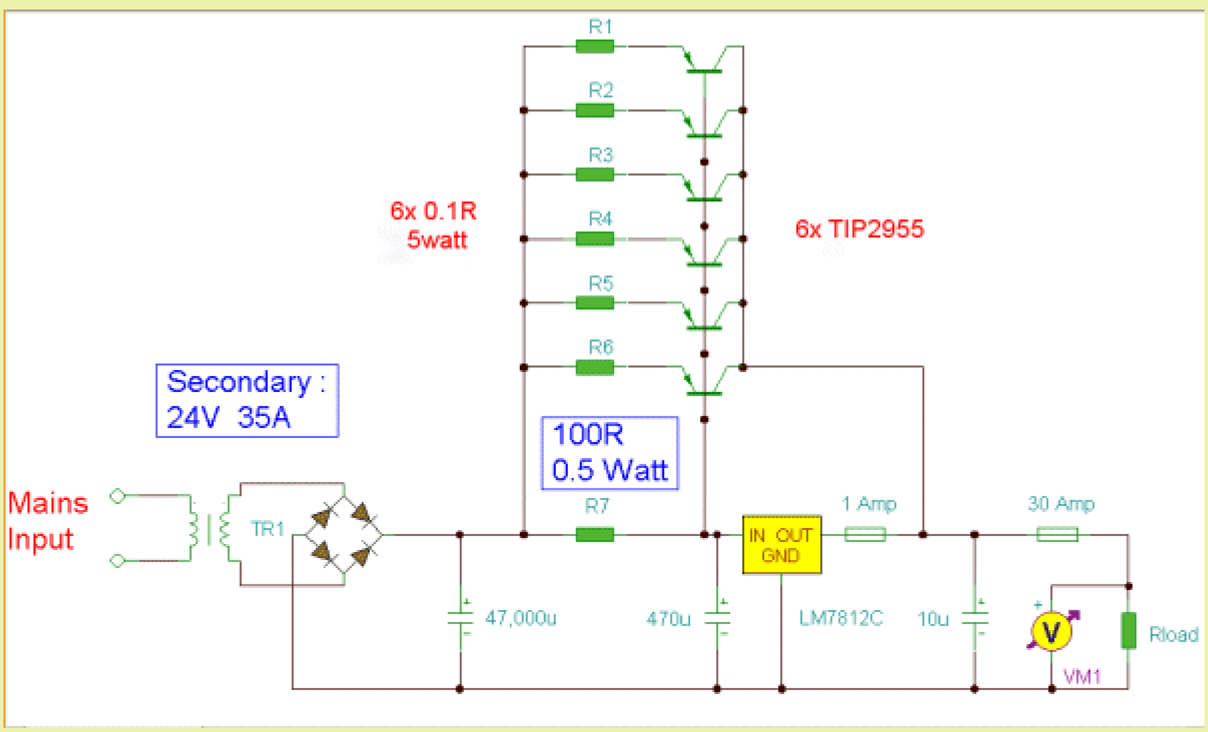
This is one of the worst kits I have seen from Velleman.
It is a LED torch using a 12v lighter battery. This battery has 8 very small cells with a capacity of 55mAHr.
The blurb claims the battery will last 10 hours but LED1 will take 38mA when the battery is fresh. Firstly, this is too much for a LED and the battery will last less than 1 hour.
When the battery voltage drops below 8.5v, the two white LEDs and red indictor LED are illuminated. I don't know why this has been done but it makes the LEDs illuminate very dull when the battery is low.

MOSQUITO REPELLER



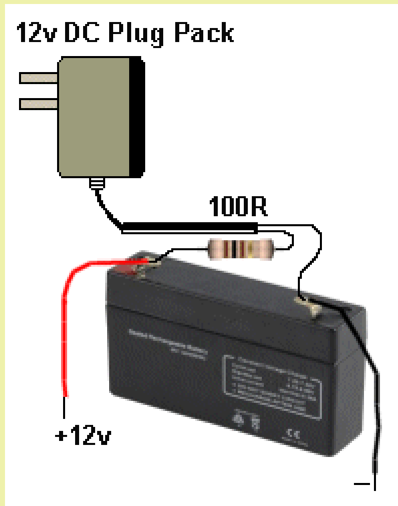
This is a timing circuit from Mohan Kumar. None of his circuit are designed correctly and this circuit has a BIG MISTAKE.
The 474 capacitor on the input will deliver 30mA and the main load in the circuit is the 1k and green LED. This means the supply voltage will be about 30v. This voltage is too high for the chip and it will be damaged.
In actual fact we don't know what the supply voltage will be as the chip will start to draw current and the supply will drop but we don't know the final voltage.
A 6v 100R relay draws 60mA at 6v, but we only have 30mA available, so we don't know what will happen when the transistor turns ON.
It's just a stupid circuit with no known operation conditions.
You cannot drive this type of circuit from a capacitor-fed power supply.

30 AMP POWER SUPPLY



If you want a 12v power supply at high current, the cheapest way is to use a 12v rechargeable battery with a trickle-charge resistor.

If you want high current for a long period of time, use a larger battery (car battery).
High current power supplies have enormous problems, mainly due to the heat they generate (waste) and the danger of one transistor short-circuiting and delivering 30v to the equipment you are powering.
In the circuit above, more than 500 watts will be wasted as heat when 30 amps flows and this will be like a small radiator bar.
You only build a circuit (make a project) when it is economic and reasonable. If there is a cheaper alternative (such as a ready-made power supply), it is better to get the guaranteed performer.
Electronic construction only came about 80 years ago, because products (such as radios, CB radios and amateur radios were not available, or were very expensive).
It's wonderful to learn about electronics, but if the cost of building it yourself is 3 times the cost of a ready-built item, you have to weigh up the economics.
The output voltage of the 24v transformer is too high as it will deliver 30 volts after the bridge and the circuit only needs 18v for it to operate fully. It needs a 16v transformer and these are not readily available.
That's why a project like this requires a lot of decisions before you commence construction. It also needs an enormous amount of heatsinking, and this is expensive.



But here is a question posted by a forum member.
He wanted to replace the TIP2955 transistors with MJ11015 Darlington transistors.
He asked if the 200 watt dissipation MJ11015 transistors would work better than the 90 watt dissipation TIP2955 transistors.
There are a couple of points to note, before giving an answer.
The voltage on the output of the bridge is 30v and the output voltage is 12v. The difference is 18v and the current is 30 amps. This produces 18 x 30 = 540 watts of wasted energy.
It does not matter if the wastage is though resistors or any type of transistor. The heat being lost is 540 watts.
Each transistor will dissipate 90 watts and this is the maximum for a TIP2955 transistor.
But don't forget the MJ11015 transistor is almost identical and to think it will dissipate 200 watts is stretching reality.
Both transistors will get extremely hot and you will need a heatsink 300mm x 300mm to keep them cool.
Just because the MJ11015 transistor is capable of dissipating 200 watts, does not mean it will be a batter performer.
Both transistors are likely to short-out under these conditions and I would never run a transistor to its maximum temperature. You are only asking for trouble.
The only difference between the two devices is the base current.
The MJ11015 transistor will require only 1% of the base current and the 7812 will run much cooler.

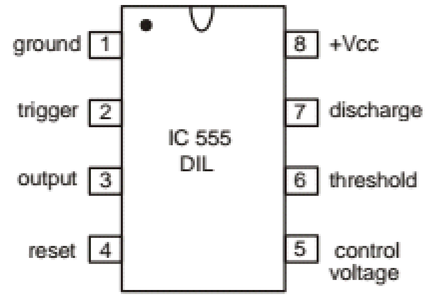
Vidyasagar Sir's Perfect Answers for HSC Board Exam, www.vsagar.org

Here is his silly explanations of the 555 pins:

Answer: IC 555 timer is 8-pin dual-in-line timer IC used in wide range of applications like timer square wave generator, burglar alarm, etc.

The pin configuration and function of the IC is given below –

Pin-1: It is ground pin connected to -ve terminal of battery



Pin-2: It is trigger pin. It triggers the time counting of the IC.

Pin-3: The output pin where we get timer result.

Pin-4: Reset pin to interrupt the time counting.

Pin-5: Control voltage pin used to set the charging and discharging limits of the external capacitor.

Pin-7: Discharging pin, to discharge the external capacitor in to it.

Pin-8: Positive supply pin. The battery supply to this IC is connected between the pin-8 and pin-1.

Where is pin 6?

Pin 2 triggers the chip when the voltage is less than 33% of rail voltage. He does not say that.
Pin 7 discharges the capacitor to the negative rail. You don't say: "into the pin."
Pin 8. The supply is not always a battery.

We don't say "counting" for a 555 chip. We leave the word COUNTING for chips that COUNT

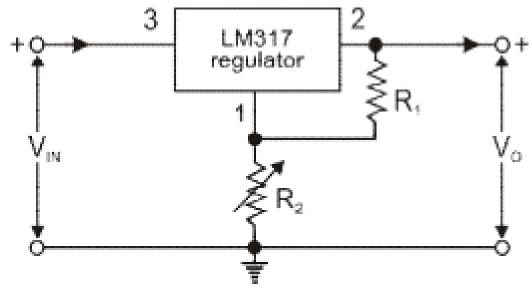
Vidyasagar Sir's Perfect Answers for HSC Board Exam, www.vsagar.org

Here is his poor explanation for the LM317 3-terminal regulator:

Answer: IC LM317 can be used as adjustable voltage regulator as follows –

In this circuit, the unregulated input voltage is connected between the pin-3 and ground and output is taken between pin-2 and ground.

The pin-1 of the IC is connected to a variable resistor (R2) and a fixed resistor (R1), as shown below.



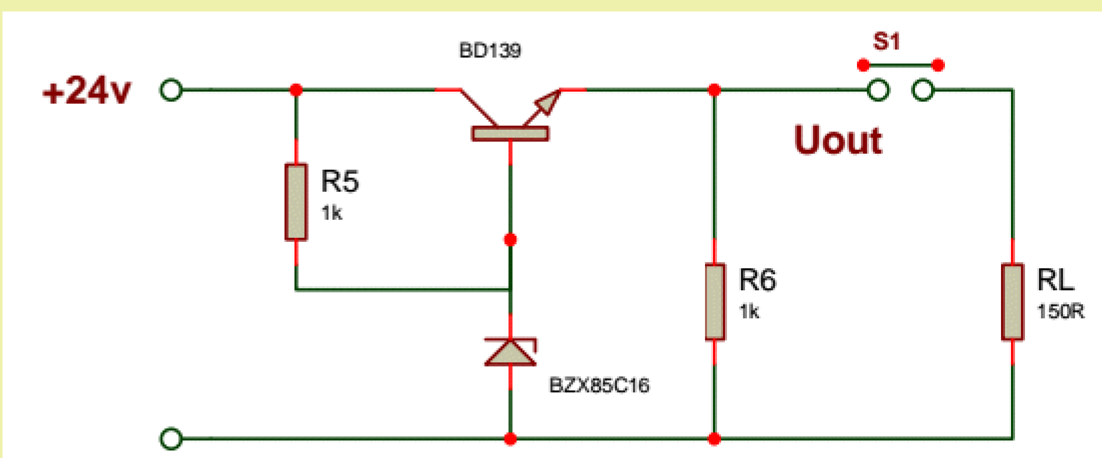
Now we can change the output voltage by adjusting variable resistor R2. The value of output voltage is given by the formula –

$$Vo = 1.25.[1 + (R2/R1)]$$

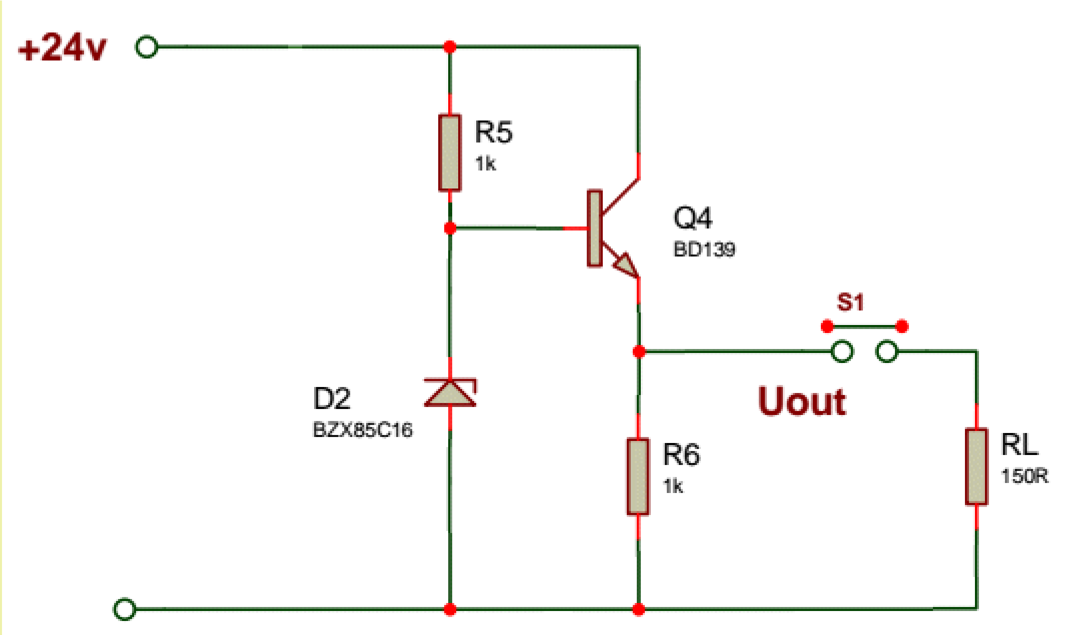
Where, Vref = 1.25 ... standard value

It would be much clearer to say the minimum output voltage of the LM317 regulator is 1.25v when pin 1 is connected to 0v .
As the resistance of R2 is increased, the output voltage passes down R1 and creates a voltage across R2 that "jacks-up" the regulator and the output voltage rises. The output voltage is always 1.25v higher than pin 1 and the regulator can be "jacked up" to nearly 35v. Now I understand what is happening.

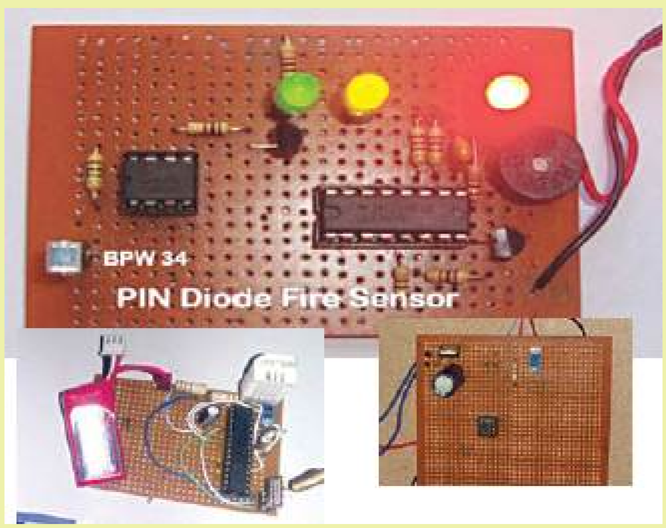
SERIAL REGULATOR



The layout of a circuit is very important to prevent it being read incorrectly.
You may think the circuit above has a good layout, but when you see the improved layout below, you can see the output of the transistor has been drawn closer to the 0v rail to emphasis the relative voltage levels.
It might be a small matter but all these things help to make a circuit easy to understand.



NO PRINTED CIRCUIT BOARDS



Going through the last 12 months of **Electronics For You** you find ALL the projects have been built on matrix boards and not one project has a photo of the finished item on a Printed Circuit Board.
Even though many projects have a PCB layout in the magazine, none of them have had a board created and loaded with components.
Electronics For You is the largest electronics magazine in India and NONE of the projects have been finalised and proven successful.
Every other magazine in the world takes a photo of the finished design and offers boards to the constructors who want to build the project. But not **Electronics For You.**

Here's a prototype from **Electronics For You** April 2016:

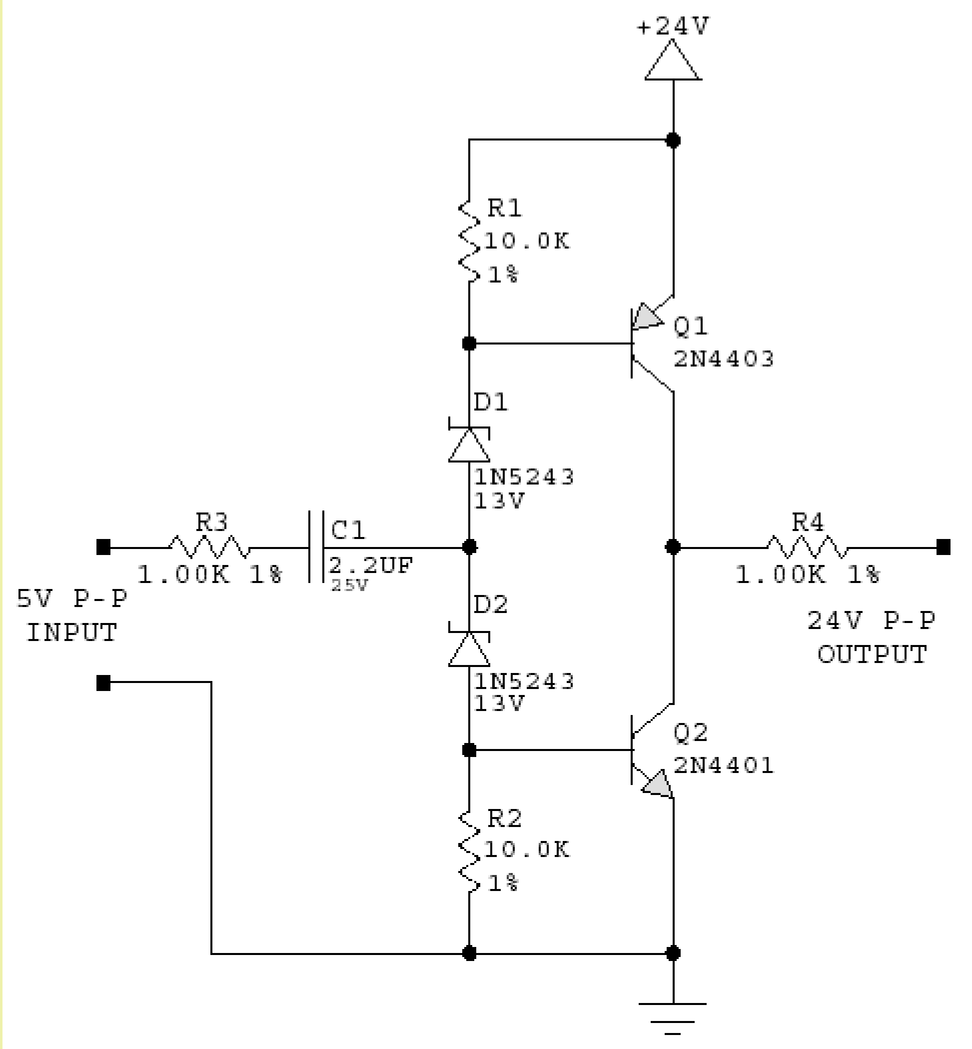
This is the sort of quality presented in the largest electronics magazine in India !! A junk board with hand-writing on the top of the board. I would not have this sort of junk in my work-room, let alone send it off to a magazine. Look at the resistor and jumper at 45 degrees!!! **Electronics For You** is just an embarrassment.

MAGNETIC GENERATOR

This is a SCAM.
It uses the good name of Tesla in an attempt to pretend he invented a motor-generator type of set-up that produces electricity without any energy entering the system
This is called OVER-UNITY and so-far no-one has created such a device.
However they claim over 10,000 investors are already powering their houses with the "device."
No-on has an open-house to show their apparatus. No-one has a video and no news organisation has interviewed anyone with a demonstration. It's just waste of $49 for the .pdf

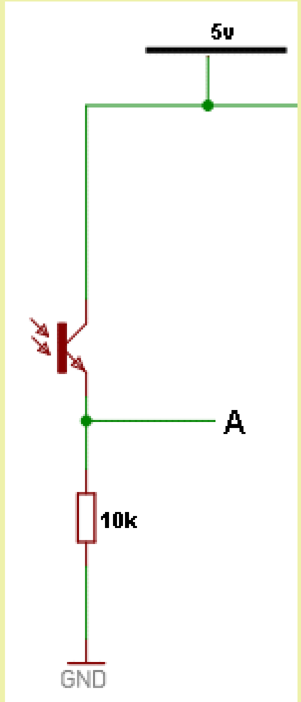
Here's the .pdf TESLA'S SECRET $49.00 !!
and here's another fraud: RUN YOUR CAR ON WATER $69.00 !!

DRIVER CIRCUIT



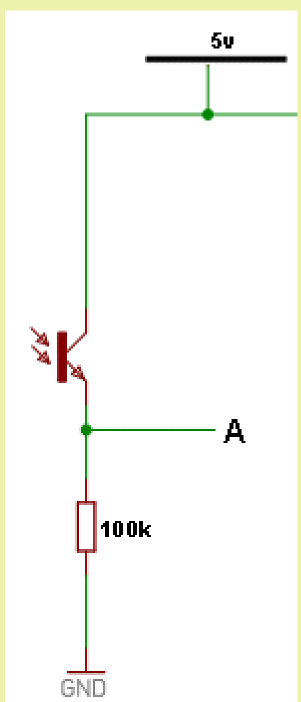
This circuit looks to be suitable but you have to do the "maths" to see how it will perform.
To start with, the two 13v zeners will have a "dead spot" of 2v because they add up to 26v for the 24v supply.
On top of this the base-emitter junctions at the top and bottom will add another 1v.
This means the input voltage will not have any effect when it is rising and falling by 3v because this is the "gap" between turning on the bottom zener then the voltage falling and turning on the top zener.
Normally "biasing diodes" are just at the point of turning ON, so the rising or falling signal will pass through the diode, even when it is a few millivolts.
Any voltage below 3v will not be transferred and a 5v signal will have some attenuation in the 1k as well as the 2u2. Most 5v signals from a digital source are less than 5v as the output of most chips is 4.5v max and 0.5v min.
This gives a 4v p-p signal and the other two losses makes this circuit very unreliable.
On top of this, zeners have a 5% tolerance and another 1v may disappear.
This circuit is called an **AC AMPLIFIER**.
It only amplifies when the signal is rising or falling. When the signal is a minimum, the 2u2 starts to charge via the top 13v zener and the emitter-base junction of the top transistor.
It charges to 10v. When the signal rises to 5v, the right-side of the capacitor should rise to 15v, but at 13.6v the zener is turned ON and the base-emitter junction is active. This means only 1.4v of the 10v is removed.
When the input signal goes to zero, only 1.4v is replaced in the capacitor.
That's the first fault.
The second fault is the amount of time taken for the capacitor to charge and discharge.
The charging will be very quick because the charging resistor is 1k. It will take MUCH LESS than one second to charge and discharge.
When the input signal is 1Hz, the circuit will react in less than 100mS and for the rest of the time the output will be zero.
Thus the circuit is not designed for low frequencies.
This is one example of a circuit designed by an "electronics engineer" who did not put enough thought into the design. Before you publish anything, build the circuit and test it thoroughly. This way you will not release something that dos not work.

PHOTO TRANSISTOR



ORIGINAL CIRCUIT

This circuit may or may not work. The hobbyist says it does not work.
Let's see why:
The circuit is a simple VOLTAGE DIVIDER.
The voltage at "A" will be 2.5v when the photo transistor has a resistance of 10k.
The voltage at "A" will be 4.5v when the photo transistor has a resistance of 1k.
The hobbyist needs a voltage of 3.5v but the photo transistor needs a very bright light to achieve this voltage.



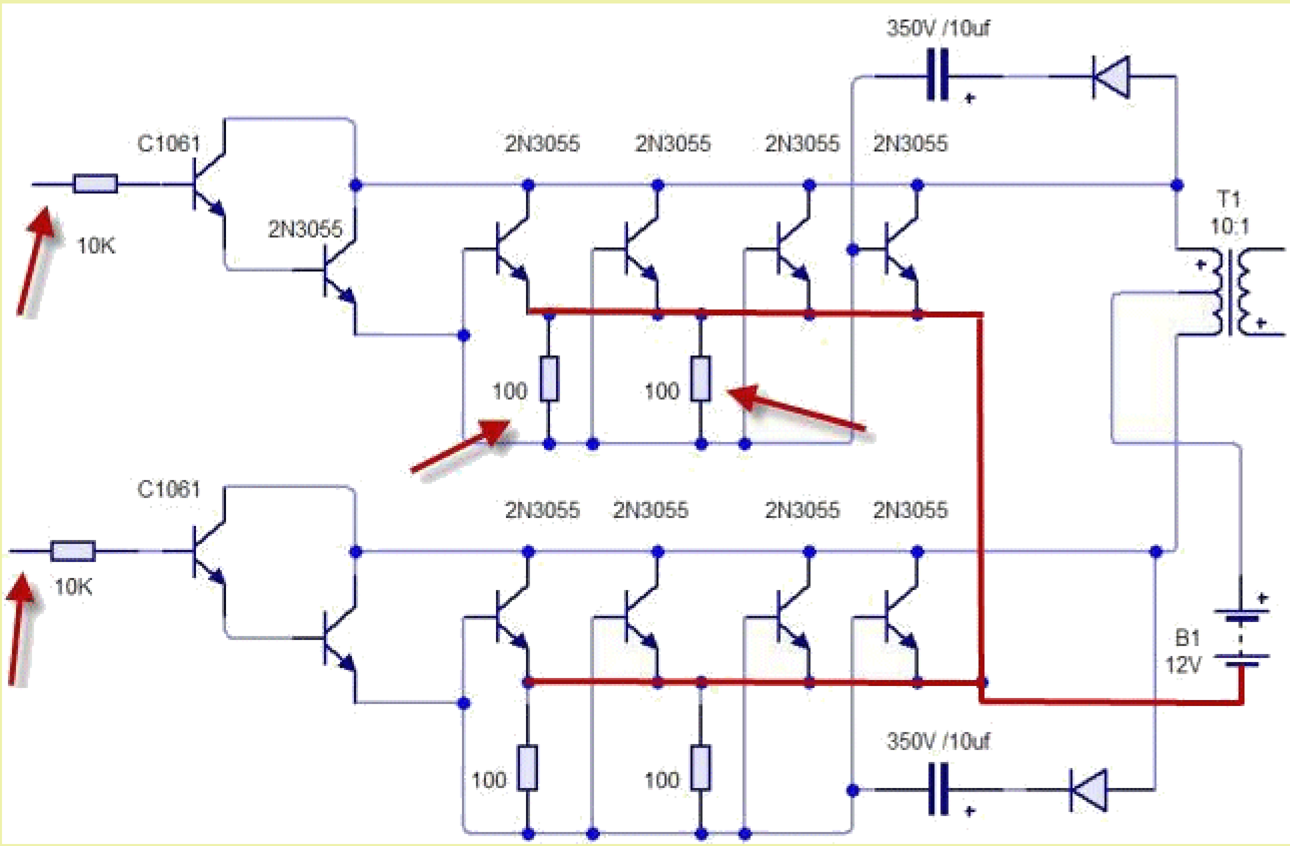
IMPROVED CIRCUIT

The answer is to change the 10k for 100k.

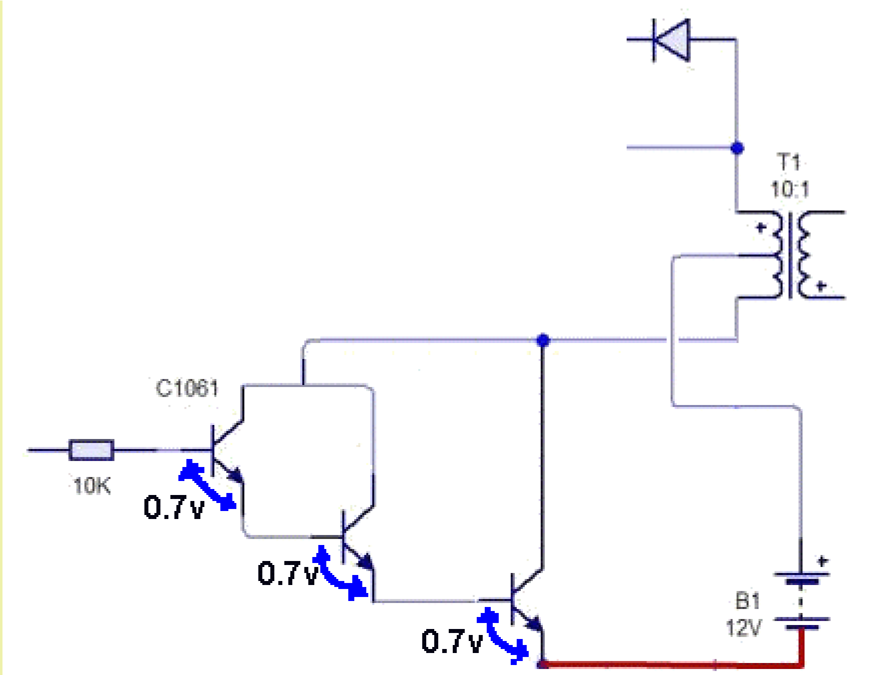
The voltage at "A" will be 2.5v when the photo transistor has a resistance of 100k.
The voltage at "A" will be 4.5v when the photo transistor has a resistance of 10k.

The photo transistor has a resistance of less than 10k in normal light and the circuit will now work.

PUSH-PULL



The main problem with this circuit is the driver stage that turns on the 4 parallel 2N3055 transistors.
When the 4 transistors turn ON, the collector voltage will drop to a very small value.
But the collector voltage of the C1061 cannot fall below the emitter voltage, otherwise the transistor will not deliver a current via the emitter.



When the input goes HIGH, the base of the C1061 will be 2.1v above the 0v rail.
When the 3rd transistor turns ON, the collector cannot fall below about 2v because the collector of the C1061 must have a voltage above the emitter for current to flow. This means the voltage across the 4 x 2N3055 transistors will be at least 2v and they will not be fully turned ON.

PCB PATTERN

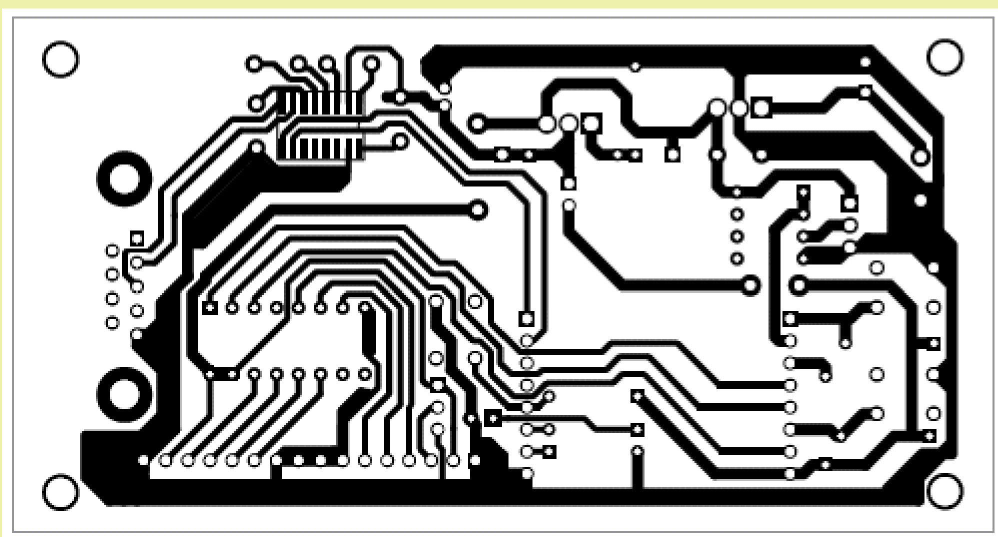
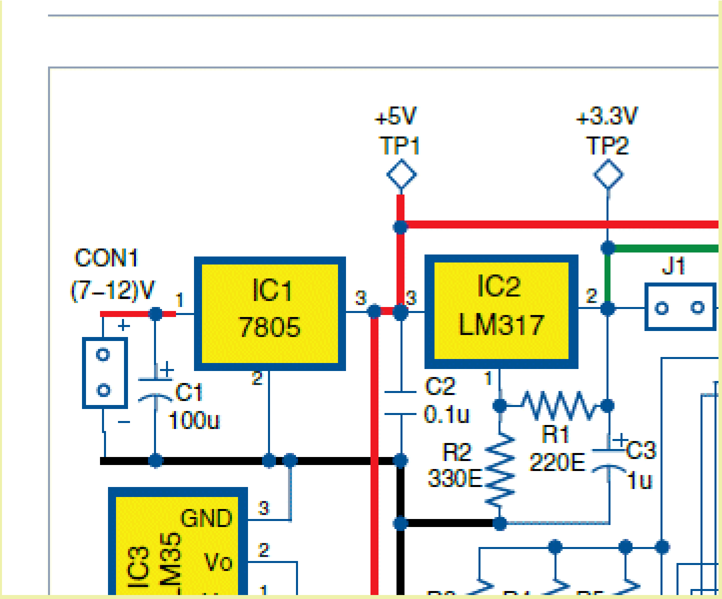


Fig. 8: Actual-size PCB pattern of the main board

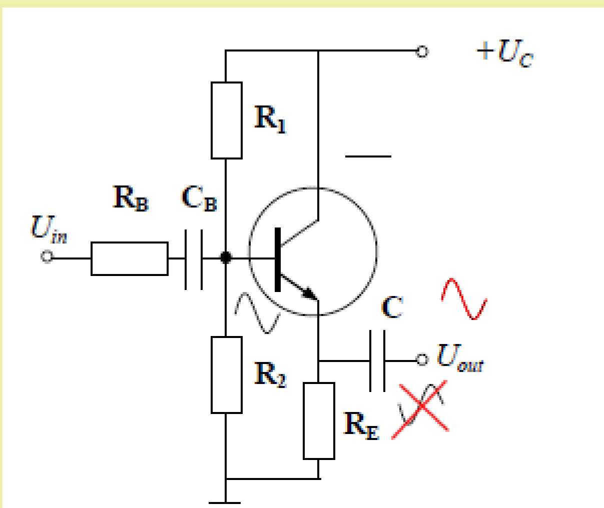
Look at the outline of the IC. It is creating a short-circuit for all the tracks going to the IC. It has not been removed from the trackwork before publication. Just another sloppy bit of work from **Electronics For You.**

3-TERMINAL REGULATORS

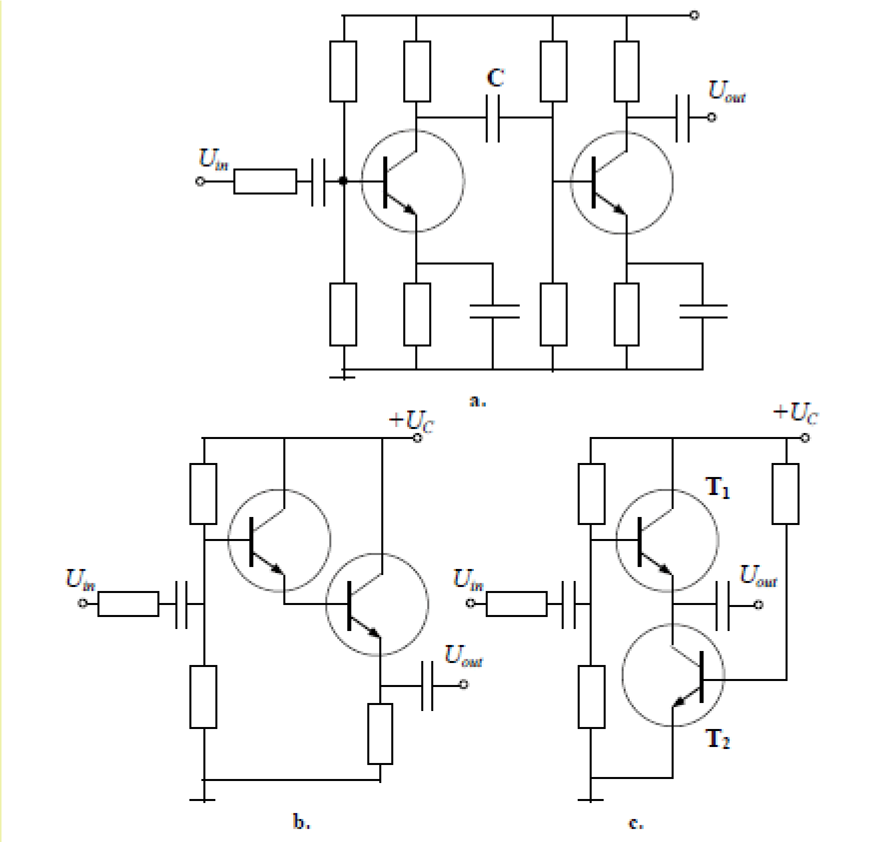


There's two faults with this circuit from **Electronics For You** April 2016.
A 3-terminal regulator needs about 2-3 across it for reliable operation. You can get low-dropout regulators to replace the "old-style" regulators and they have a lower dropout (350mV to 1v or so).
In the circuit above, the 7805 needs 2v across it and if the input voltage falls below 7v, the circuit will not work properly.
The LM317 needs 1.7v and only 1.6v is available. Use low drop-out regulators for both these regulators for reliable operation.

EMITTER-FOLLOWER

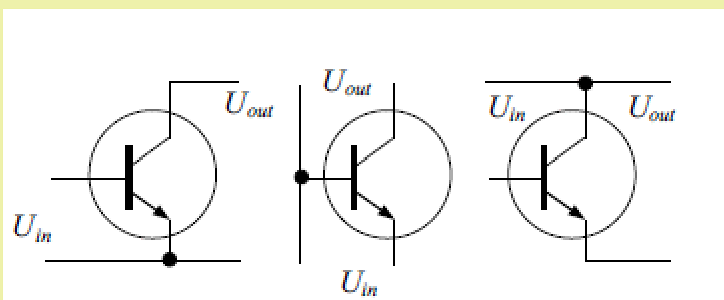


The output of an emitter-follower is in-phase with the input. The red waveform in the circuit above shows the correct output.



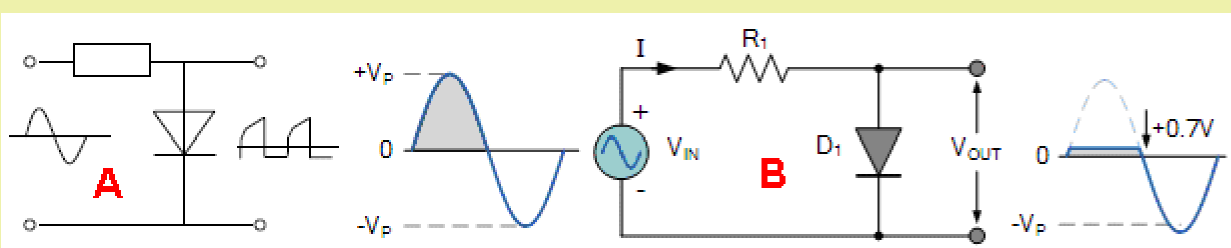
What is the use of putting a circuit in a text-book without any values ???? It's only the values that will let you know what the circuit is doing and how it is biased.

Look at this RUBBISH:



The centre figure is supposed to represent COMMON BASE configuration. If I don't understand the circuit, how is a beginner going to understand it ???

DIODE CLIPPER

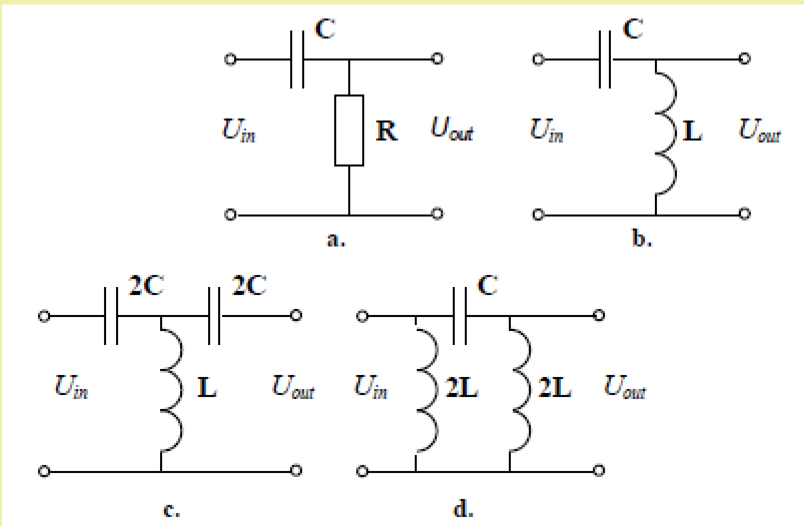


The output waveform of diagram A is entirely incorrect. See the output of diagram B. The max voltage will be 0.7v as the diode turns ON at this voltage and when the waveform goes negative, the diode is effectively "out-of-circuit."

Here is some of the terrible Engwish from: **Introduction to Electronic Engineering** By: **Valery Vodovozov** Here is the book as 3.7MB .pdf

Feedbacks. The main toop to improve the frequency response or the step response is a feedback.
When R2 = 0, the current amplifier is a voltage repeater because the voltage gain is equal to unit.
Besides stabilizing of transresistance, the inverting feedback has the same benefits as the non-inverting voltage feedback that is decreasing distortion and output offset.
Conventionally, energy approaches electrical end electronic systems from the power generators of different types: hydro, wind, and heat generators, atomic stations, etc.
Summary. A power supplier has to meet the requirements of the energy consumer, which needs the determined power, voltage, and current values and shape. Voltage sources supply fully controlled voltage, whereas the current may be unpredictable. Current sources generate adjustable current flow, whereas the voltage may change during the supply process. In practice, there is neither the pure voltage nor the exclusively current sources, but one of the features is predominant.
Passive low-pass filters. A low-pass filter reduces high-frequency particles of a signal and passes its low-frequency part.
Nevertheless, in power circuits, they function as the protective devices for the load under the shorts.

FILTER

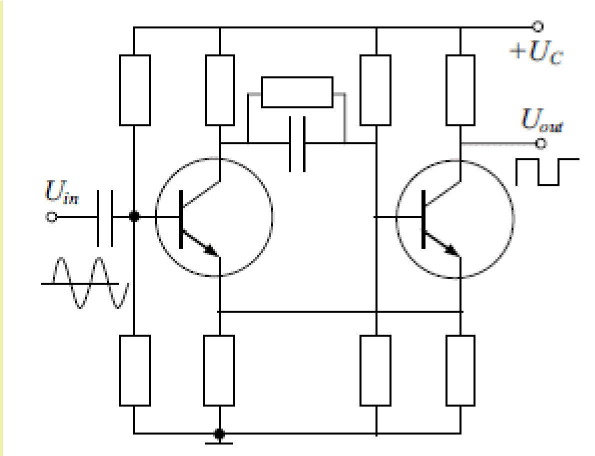


Passive high-pass filters. *The circuits above are high-pass filters. The high pass filter is open for high frequencies and attenuates the low-frequency signals. High frequencies pass through the capacitors but the low-frequency signals are attenuated by the capacitors. On the other hand, the low-frequency signals pass through the inductors, whereas the high-frequency signals cannot pass over the coils.* WHAT RUBBISH !!

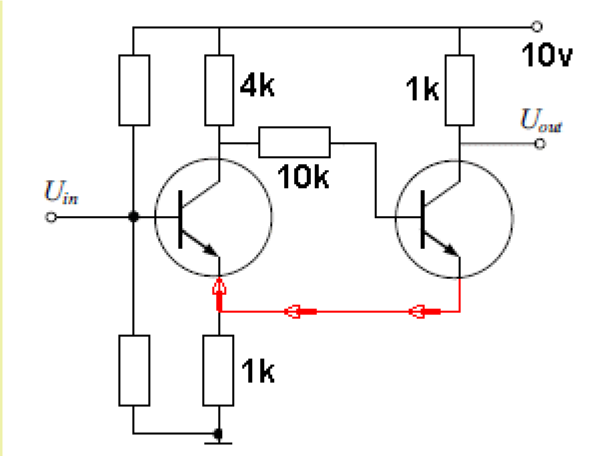
High frequency signals pass through a capacitor because the waveform on the left plate rises and falls very rapidly and this makes the waveform on the right plate rise and fall at the same rate and the capacitor does not have time to charge and discharge.
A high frequency signal appearing on the top of a coil produces an opposing voltage from the coil that prevents the energy in the waveform entering the coil and passing to 0v - because the opposing voltage has the same amplitude and prevents the waveform passing through the coil.
It is exactly like walking on a swimming pool filled with corn starch.
https://www.youtube.com/watch?v=D-wxnID2q4A
If you run very quickly across the pool you will not sink into the corn starch solution.
But if you stop, you will sink.
If the signal is low frequency, the opposing voltage from the coil has a low amplitude and the waveform passes through the coil (because it has a very low resistance).

It is the desire of all designers to achieve accurate and tight regulation of the output voltages for customer use. To accomplish this, high gain is required. However, with high gain instability comes. Therefore, the gain and the responsiveness of the feedback path must be tailored to the adjusted process. ????????

SCHMITT TRIGGER



The whole idea of explaining how a Schmitt Trigger works is to show the feedback from the second stage (transistor) to the first transistor. This is shown in **red.**
Normally the first transistor will produce a change on the collector when the input changes by about 0.7v This is normal transistor action in a common-emitter circuit. This means a small input signal will change the output. In fact a change of as little as 100mV will affect the circuit. But when we have a feedback line as in this circuit, the operation is completely different.
Suppose the input waveform contains noise of 100mV. This noise will affect the output in a normal amplifier.
To prevent it affecting the circuit we increase the distance between the low and high trigger points to say 3v.
This "gap" is called the HYSTERESIS GAP.
The circuit below has values to emphasize how the input works.
Suppose the first transistor is turned ON. The voltage between the collector-emitter terminals will be less than 700mV (about 300mV) and the second transistor will be OFF. The second transistor sees 300mV between base and emitter and it will be turned OFF.
The voltage across the 4k will be 8v and the voltage across the 1k will be 2v.
The voltage on the base of the first transistor will be 2.7v
To turn the first transistor OFF, the voltage must be reduced.
When it is reduced by 100mV, the first transistor begins to turn OFF and the voltage on the collector rises. This turns ON the second transistor and the current through the two 1k resistors produces a voltage across the lower 1k. This raises the emitter voltage and although the base voltage DOES NOT RISE at this point in time, the voltage between the base and emitter of the first transistor is REDUCED. This turns OFF the first transistor and this is done without the input voltage changing. It is the SWITCHING ACTION of the two transistors that cause the circuit to change states.
The two transistors continue this action until the first transistor is completely turned OFF and the second transistor is completely turned ON. This action is called REGENERATIVE ACTION and means the action continues within the circuit without any external influence.
The circuit finished up with the voltage across the top 1k as 5v and across the lower 1k as 5v.
The base is still at 2.6v The first transistor is completely OFF and the second transistor is completely ON.
To turn ON the first transistor the input signal has to rise to 5.7v
This is a 3.1v rise and we have changed the circuit from 0.7v detection to about 3.1v detection.
The important fact to remember is the circuit creates the rapid switching action and NOT the input signal and the gap between HIGH and LOW is about 3v.
The signal shown in red is called a FEEDBACK signal.
It is a POSITIVE FEEDBACK signal because it assists the input signal in performing its intended task.
With a feedback signal, you cannot consider a signal that is of the same polarity as being positive.
The signal is really ASSISTING (helping); or HINDERING (opposing) and can be rising or falling and yet ASSIST the incoming signal.



Of course the author of the book has good intentions. But English is his second language, however every page has left me wondering what he is trying to say. Some of the statements don't make any sense AT ALL. That's why I only use very simple English and don't try to show my ability at use large, complex words and long, involved sentences. The first time you use a long sentence, the reader will close the book and put it on the shelf. You have lost him forever.

You are not trying to show how clever YOU are. You are trying to get a complex point across by saying it is really very simple to understand.

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SPOT THE MISTAKES!

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A recent visitor in an electronics forum asked: "Is electronics dying?"
We all know electronics is not dying because everything you hold in your hands is based on electronics.
But the desire to learn electronics - in the hope of making it a career - has changed enormously.
50 years ago you could become a technician - a radio technician, communications engineer, 2-way radio installer, repairer, CB radio stockist, radio station technician, car radio installer or repairman. You could design and manufacture amplifiers for music, guitar, schools, offices. Install 2-way radios for taxis. Service black and white TV's and colour TV's.
The field and market was enormous.
Servicemen worked from 8 in the morning to 11 at night, 7 days a week. Everyone wanted amplifiers, TV's and sound systems.
Then the Japanese and Chinese came in with products that were cheaper than the cost of a repair.
And servicing went out the window.
Now, nothing gets serviced or repaired.
That's what changed the industry.
In addition, all manufacturing went overseas.
What are we left with?
Just a few sales.
And this can be done by juniors, just out of school, with 2 weeks training.
You don't need anyone with an electronics background as nothing will be pulled-apart, fixed or serviced.
So, what about design?
This has gone overseas too.
Even though the Chinese had no mechanical or technical ability, some 50 years ago (you just have to look at their farm machinery and cars etc) they sent their students

overseas to acquire the latest technology in EVERY field and are now at the forefront of advanced designs.
Even though some of their designs are clumsy and faulty, they learn from their mistakes and after the third or fourth generation, their product is fully acceptable.
And now it has come to a point where you cannot compete. They have taken over and dominated the market in so many areas that the mechanical and electronics industries are their complete domain.
So, what do you do?
The only markets left are niche markets, that are small-return. Areas such as medical aids and disability aids. There are thousands of people that need devices to assist them in their daily life such as a simple multi-function robot that can be programmed to carry out one or more tasks.
Devices to help people eat, drink, wash, etc and be self-sufficient.
This is one area that has not yet been explored and is an ideal place to start.

Talking Electronics has produced a number of pieces of test gear to help in designing circuits.
These include a transistor tester, LED tester, Logic Probe, pulser and a continuity tester.
It would be wonderful to say we have sold lots of these kits, but the truth is: we haven't.
I designed these projects because I needed them and I use them all the time to get a project working.
The LED tester is the simplest and the best.
It tests all type of LEDs because many of the new LEDs are clear and only show the colour when powered.
It is also a continuity tester as the LED on the board illuminates when a low resistance is present.
And the Logic Probe is very useful too. It found a short-circuit in a new PCB that prevented the micro from starting-up. The Logic Probe proved a signal was not present on the oscillator output and the short-circuit was located.
Test gear does not solve all your problems and the most dangerous item to use is a CRO.
Unless you know what to look for, the trace on the screen will contain all sorts of junk and spikes that the circuit may or may not be responding to.
The trace can lead you in the wrong direction and "a little knowledge is a dangerous thing."
However there are many items of test equipment that are essential and that means a multimeter. This is the first thing you should acquire. Even the smallest and cheapest can be used and you should have both an analogue meter as well as a digital meter because some circuits work better with one and not the other. Simply get both and try them to see what I mean.

Talking Electronics website concentrates on explaining the BASICS of electronics.
xxxxxxxxxxxxxxxx

Introduction to Electronic Engineering By: **Valery Vodovozov** is an example of trying to explain the basics but using complex equations and failing to provide simple examples.
The book doesn't suit the advanced engineer and doesn't explain to the beginner.
There are lots of text books like this and that's why you should download a free .pdf of the book before thinking about purchasing a hard copy.
We get emails and calls every week from readers who have been with us for over 20 years and some are re-entering the field as a hobbyist in their retirement.
They say we have covered more and explained things better than any of the courses thy have undertaken and one of the most important sections is this section: SPOT THE MISTAKES.
It covers all those things that you cannot explain in a normal article and covers "real life" incidences in fault-finding and circuit development.
That's why we have continued to add to these pages and every time I open up a book on basic electronics, I find more things to add to the list.

One of the brilliant ideas introduced some 30 years ago was the concept of a COMPUTER SWAP-MEET.
This introduced the software developers to the budding computer enthusiasts and started the revolution of sharing software for as little as $5.00 per disk.
It was basically called PUBLIC DOMAIN SOFTWARE and was designed for sharing and improvement by anyone interested in programming.
At the time the internet was in its infancy and speeds as slow as 300 baud was the only way to connect.
There was no Google and you had to type the address accurately to get connected.
What happened next?
Computer clones came on the market and the quality of software exploded.
But what I want to say is this.
At present there is no unifying "hub" or single location where all those interested in electronics can meet and/or receive the latest in technology.
There are many Forums and a number of websites run by manufacturers, magazines or individuals, but nothing for the beginner and experimenter.
"Make" and "Instructables" websites have some features but nothing is indexed or easily navigable. And some of the projects don't work or are poorly designed.
That's why basic electronics is dying.
Very few magazines have simple projects. In fact I have not seen a simple project in a magazine for the past 12 months. And there are no magazines that back-up any of the projects with a kit of components.
This makes it difficult, if not impossible, for a beginner to put a project together.
And things are getting worse.
Many magazines are in their last year of publication. Sales figures are falling and just

like the death of the daily newspaper, the internet has taken over everything in the publishing world. Even women's magazines, health and all those mass-circulation titles have fallen to miserly levels due to the ease and efficiency of reading everything on the web.

The greatest success of the web is the hyperlink. Every article and every page has a link to another page and you can wander through a dozen links on similar topics.

And the search-rate is phenomenal. A cat video with 18 million hits in 10 days shows the amount of activity on the web, looking for something to view.

Talking Electronics website has had over 22 million visitors.

Many of these have been invalid landings but the average for interested visitors has been over 7 minutes per page.

The internet reaches every country in the world and readers who could never afford to buy a magazine are now accessing everything for FREE.

Originally websites tried to sign up readers at a few dollars per month, but this was over-ridden by free sites and now everything is FREE.

INDIA

India is trying to rise in the world of technology and the only real thing that is happening in the country is the rise of wealth for many millions of people.

The increase in prosperity has come about from the employment of thousands of people in call centres, where they originally earned $20 per week. When you multiply the effect of thousands earning this money over a period of 20 years and the flow-on effect of money changing hands two times a week, you finish up with tens of thousands of people living a good life-style and feeding their whole family.

This simple beginning has produced and enormous number of middle-class workers and this has been re-enforced by the fact the the money could not be taken over-seas.

But all this has been generated by the simple fact that the Indians could speak English and "pretended" they were "just down the road" from the caller.

In fact they were working AT NIGHT.

When the truth finally came out, there was an uproar with overseas foreign call centres and staff were gradually re-installed in the originating countries.

India produced a lot of new wealth but technology did not improve.

As far as technology is concerned, they relied on importing and copying from overseas.

The main field has been supplying medicines after the patent has run out.

A small amount of electronics manufacture has been tried but failed as well as a number of IC's bearing their own part numbers.

Their electronics magazines try to put up a bold front and instead of saying "made in India" the articles are headed "Make in India."

I have provided articles for one of the Indian electronics magazines for the past 18 months and in this time I have not received one single email from a reader.

Not one person has requested a kit, a printed circuit board or any assistance.

For the past 4 months the magazine has failed to present any more projects and does not even have a single circuit for a hobbyist in the magazine.
Even the largest magazine in India has a number of projects in each issue and a list of comments at the end of the article. The number of comments is ZERO !!
The magazine had an electronics forum up until 2 years ago and the comments were of such a simple nature that the magazine closed down the forum.
Yes, there has been a rise in the affluence of some of the people over the past 20 years, but you have to understand how this has come about. It has been produced by money flowing into the country for call-centre workers and not being allowed to exit the country.
A single $20 wage has generated 20 x 2 x 50 x 20 = $40,000 of purchasing power over the past 20 years. This is the enormous multiplying effect of money when it is not allowed to be removed from the country.
Now you can see how each worker has created millionaire bosses. And there are thousands of millionaires.
I am not against this or the millionaires, as they cannot eat their money. Their money goes to develop large projects such as housing, factories and employing more workers.
But you need to realise this is all "flimsy" improvement.
It is not technology-based. It is just "being able to speak English" and carry out a simple task.
With the rise in affluence from those who are working and earning dollars, families are buying solar systems for their houses and the country is extending its cell-phone and internet coverage as well as electricity generation. Some of this equipment and infrastructure is being manufactured in India, but most is imported.
For a country so intent on trying to portray "technological improvement" we don't see anything new on the scene as far as transport is concerned.
The train system has not changed or improved since the time when the English supplied locomotives, some 100 years ago and the most common mode of transport - the rickshaw - uses the polluting 2-stroke motor.
India has come a long way with the capital inflow and the aviation scene is one of enormous expansion.
But the electronics scene has not advanced.

What I am saying is this:
There is a lot of hype and presentation and flag-waving about the IT presence and performance in India but very little is actually occurring.
It takes a lot of money and know-how to create a product but most of all it takes infrastructure. Infrastructure is the ability to get someone to design something for you, someone to make it and someone to ship it to you ON TIME.
China, Japan, Taiwan, Hong Kong all have this in place and that's why they can make things.
India does not have this co-ordination in-place and they can only pretend to be

performing.
They don't have it in place because they don't need it.
They have never made anything before and it takes years to create this sort of infrastructure.
And now I come to the reality of the situation.
The level of understanding of electronics in India is very low.
You just have to look at the articles and projects submitted to magazines and the comments and feedback from readers.
It is virtually NIL. The magazine does not sell kits, does not provide the printed circuit board and does not have a technical section.
They have refused to accepts any of my projects for the past 3 years and taken no notice of the 35 major faults in their projects.
There is absolutely no-one in their production-team other than "copy-and-paste" editors that bring the magazine out each month.
And now they have ceased to include even simple projects in the magazine.
Where are they heading?
Nowhere. Because they have not not produced anything in the first place.
The magazine was just "smoke and mirrors."
But let's not be too critical.
India, is after all, a third-world country.
The only thing that shaped India was the English, making Indians speak English as a first language, covering the country with a railway system. buying goods (cotton etc) and educating the population to a point where English-type schools are sort-after by everyone able to afford the fees.

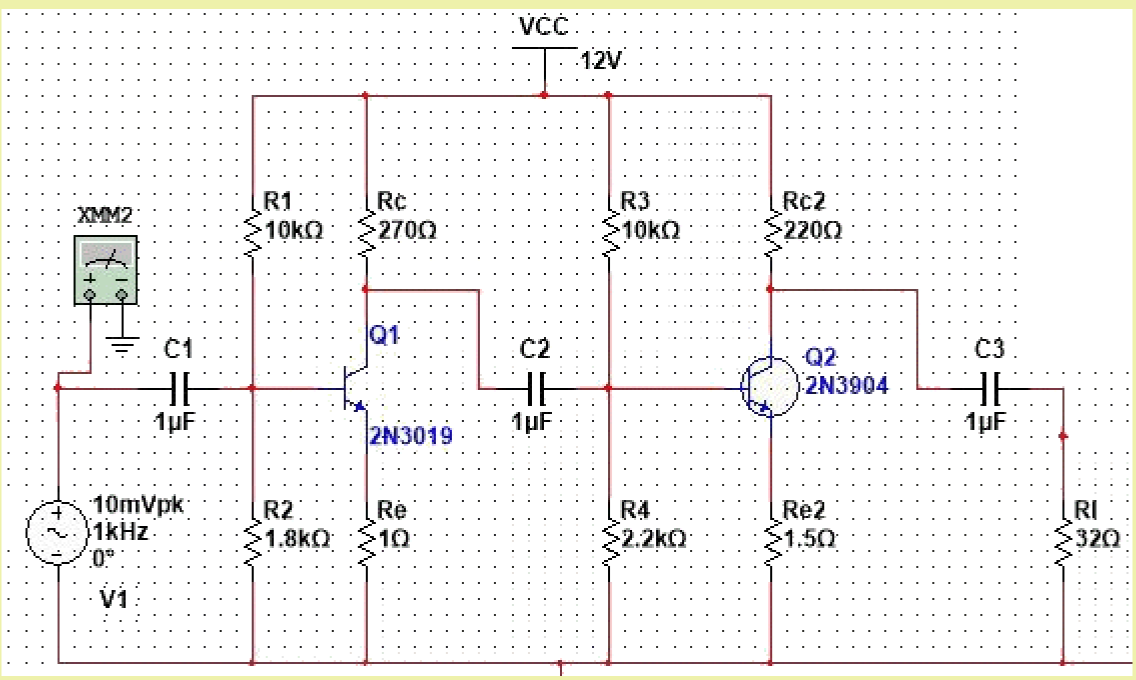
You have to look at everything realistically. I am not biased in any way. I don't have a "barrow to push." I just see things as they really are.
When you compare India with other 3rd world countries you see they are far above the rest. You have to provide a reason for this. When you see the conflict, corruption and poverty in other countries, you have to look for a root-cause reason.
The one thing that is raising the conditions of hundreds of millions of people is TECHNOLOGY.
Even though we complain about not doing enough, technology is providing food, shelter, electricity, medicine to millions and, while at the same time corruption is drawing-off 90% of the wealth that should be filtering down to the population.

COURSES

You have to be careful when thinking about enrolling in an electronics course and also

when buying an electronics text book.
Many of these courses are far too complex and cover things that are not really needed.
Electronics has advanced over the years and building a circuit with gates and has been overtaken by a microcontroller.
Similarly, a lot of problem-solving with resistors in parallel and series can simply be determined by creating the circuit and measuring with a multimeter.
You have to dedicate your time to learning things that you will use.
Many of the chapters in text books are filled with things I have not used in 50 years.
I have not found a text book that isn't filled with 75% of things you will never use and the remainder is very poorly presented.
Very few books have practical examples, using actual circuits from the field.
Most books are just words, words, words.
That's why I built this website.
It's an example of how a text book should be written.

THE OUTPUT



Here's a very simple way to work out the voltage you will get across the 32R load (32R speaker).
The first thing you have to understand is this: The energy entering the speaker is not via the transistor but via the 220R load resistor.
The output transistor merely turns ON and "empties" the 1u electrolytic. If the 220R does not "fill" the electrolytic, the transistor will have nothing to remove. And the only time the electro is "filled" is when the load is not getting its full current from the first half of the cycle. In other words, the energy missed from the first half cycle is delivered during the second half-cycle. It is not as though the second half-cycle is delivering "extra energy," it is just delivering the remains of the first half-cycle.
How many times has this been explained in a text book??? NEVER !!!!!
So, the LOAD RESISTOR is most important.
It must be a low value to deliver current to the speaker.
When the output transistor turns OFF, the 220R and 32R form a voltage divider and 13% of the 12v supply will be passed to the speaker. The 1u will rapidly charge and this "flow" will reduce during the first half of the cycle. So the maximum is just 13%. If the value is larger than 1u, the electro will fill up slower and more current will be passed to the speaker for a longer period of time.

When the transistor turns ON, the energy stored in the capacitor will come from the previous half-cycle, (during the time when the energy is being delivered at less than 13%.)
So the overall delivery for the full cycle is less than 13%.
This is how you see a circuit "working" without any mathematics and without using any simulation software.

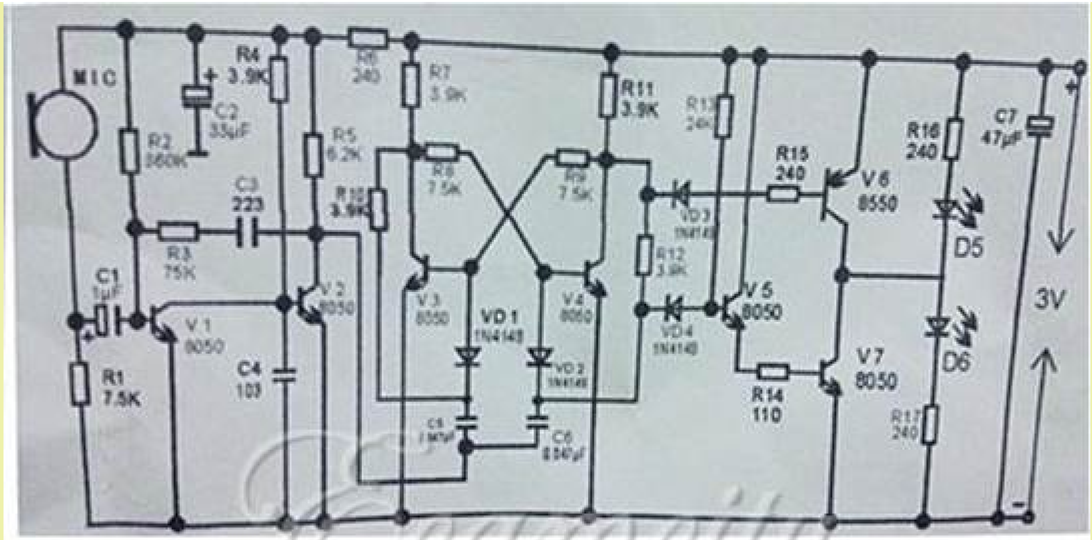
One "engineer" on the Forum replied:
As I understand the task, the amplifier should work in the quasi-linear range with a gain of 100.
Hence, the transistor is neither turned (switched) ON nor OFF.

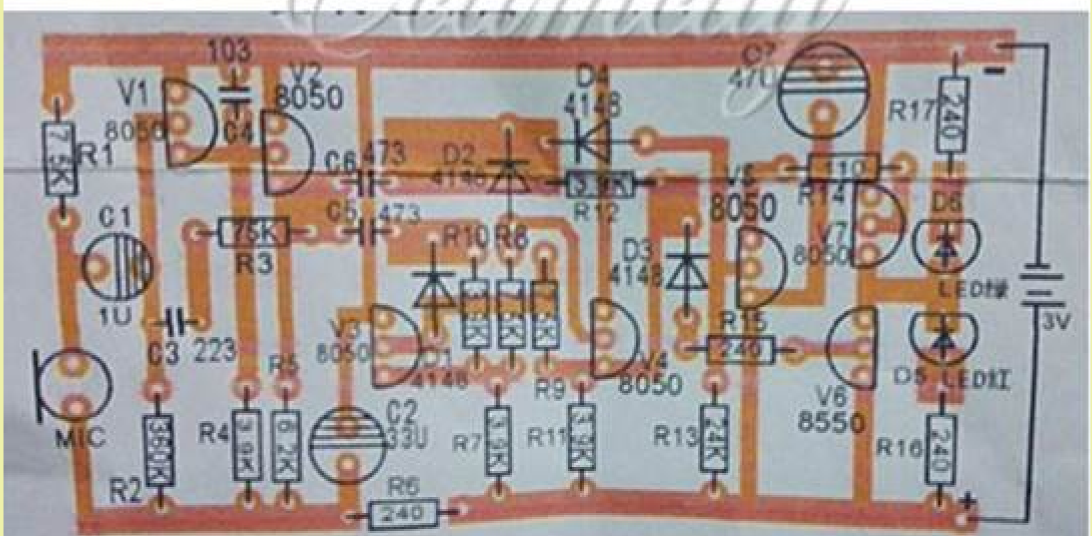
This is not so.
Here is the answer:
The output transistor will be fully turned ON. The base bias resistors are trying to put 2v on the base and this is more than enough to turn the transistor ON. The base will rise no more than about 0.7v due to the output transistor being in a common-emitter configuration.
The 10k will deliver about 1mA to the base and if the gain of the transistor is 100, this will produce 100mA through the 220R load resistor. The voltage across the resistor will be 220 x 0.1 = 22v which is clearly more than the supply voltage, so the output transistor will be FULLY TURNED ON.

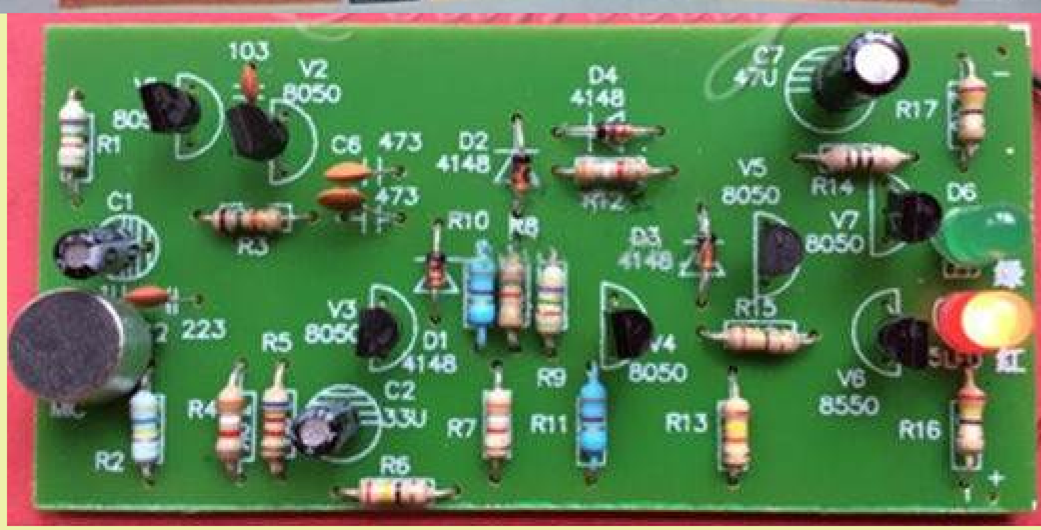
As far as the output stage turning OFF, you will have to do some complex calculations to determine if the 1u will turn the stage OFF and this is beyond our simple explanations.

WHAT'S WRONG WITH THESE:

CLAP SWITCH

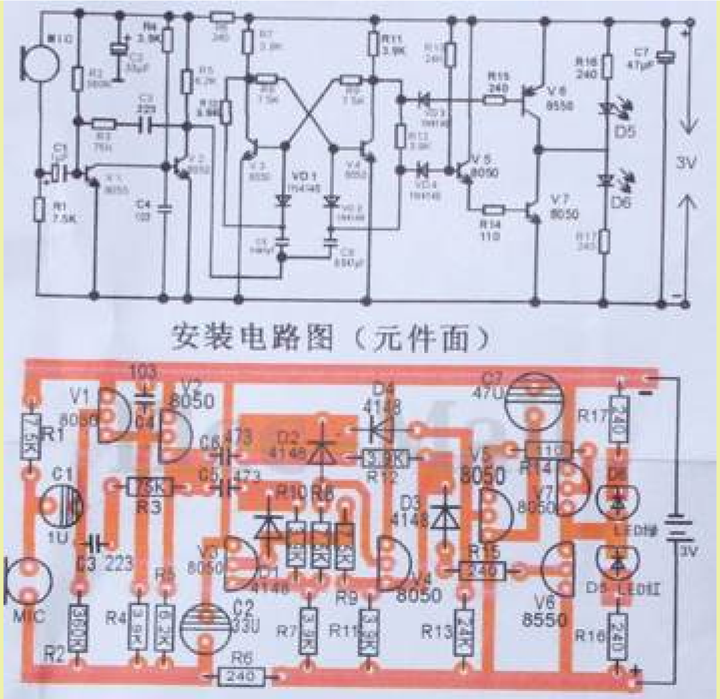






Here is a kit from India for a CLAP SWITCH.
The circuit is a common design and it works very well. But the components are placed on the board UP-SIDE-DOWN !!!!!
The positive rail is at the bottom of the board and no resistor values are identified.
I have learnt NOTHING from this kit. How do you expect a beginner to learn anything ???
The kits costs $8.00 in India.

The kit has been stolen from a Chinese manufacturer:



The kit costs $2.00 from Hong Kong !!!!!!

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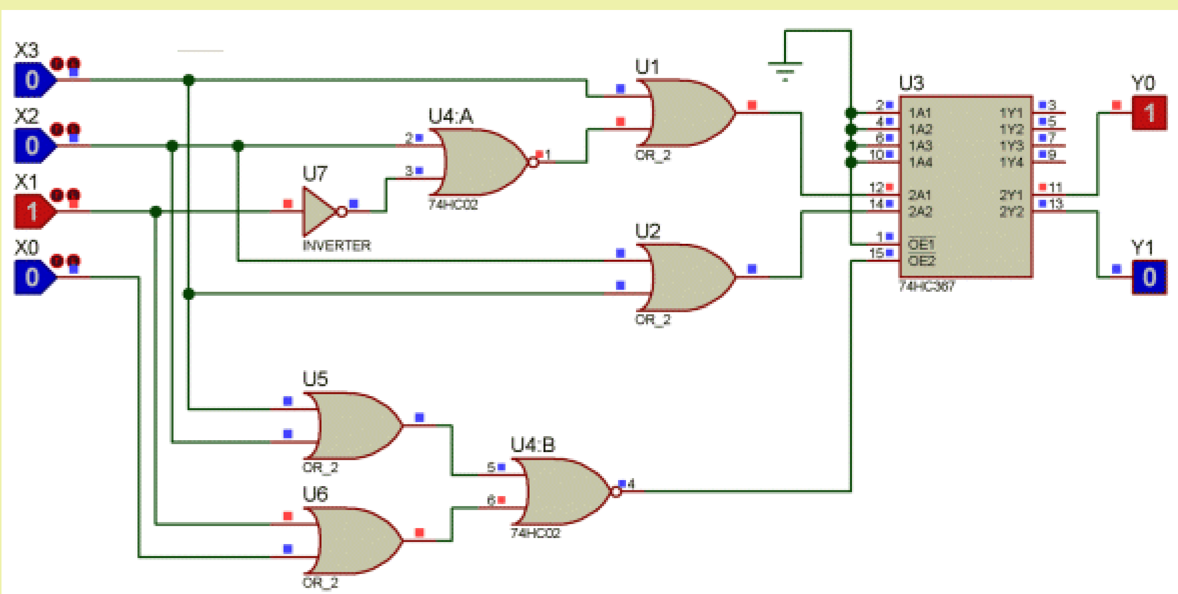
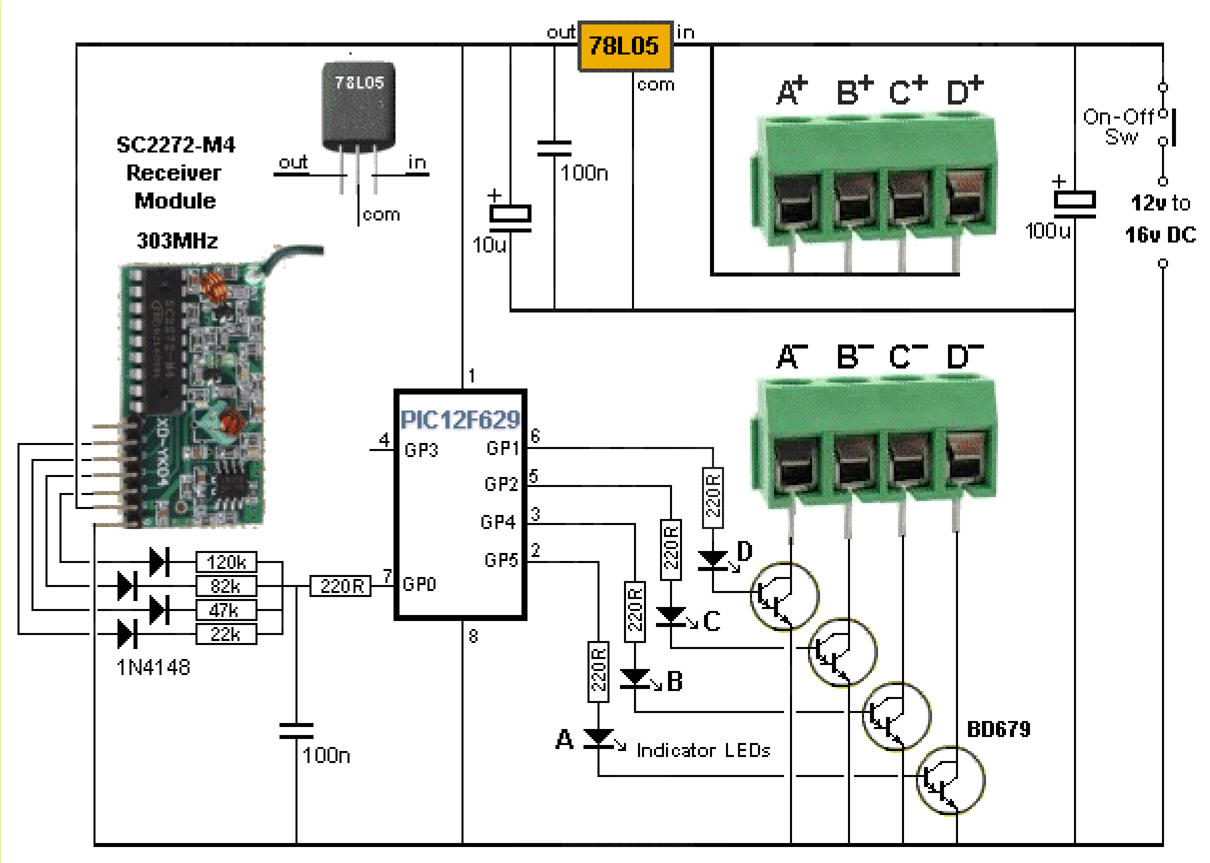
4 CHANNEL TO 2 OUTPUTS

A reader of a forum requested a circuit to take 4 outputs of a receiver and connect them to 2 inputs of his microcontroller.
Here's what an electronics engineer came up with:



It does not let you know when no input is present and is very complex in design.

Here is my circuit from a project: **4 Channel Remote Control**. It is much simpler than the circuit above and can be expanded to 6 inputs.



Picbuster replied:
Place a resistor over the 100nF. Mandatory avoid DC restoration over 100nf (avoiding an 'open/floating' GP0 input.)
To start with, the 100n across the input does not create a "floating input."
Picbuster replied with more incorrect statements:
"The input is floating with only a cap connected to it."
"How to discharge cap after loading it via the diode? (it remains high until discharged by mpu's input impedance."
An input is considered to be floating when it can pick up stray voltages and rise and fall very quickly and the micro detects values that it cannot deal with. When a 100n is connected to the input, it charges and discharges very slowly and does not charge via stray voltages or interference from electromagnetic waves.
The 100n capacitor is discharged by making the pin an OUTPUT and taking it LOW to quickly discharge the 100n.

TIMER

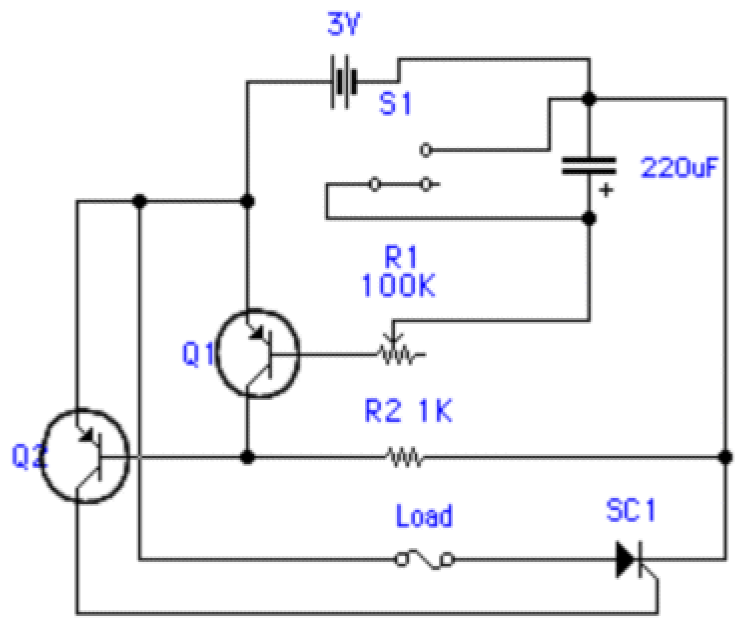
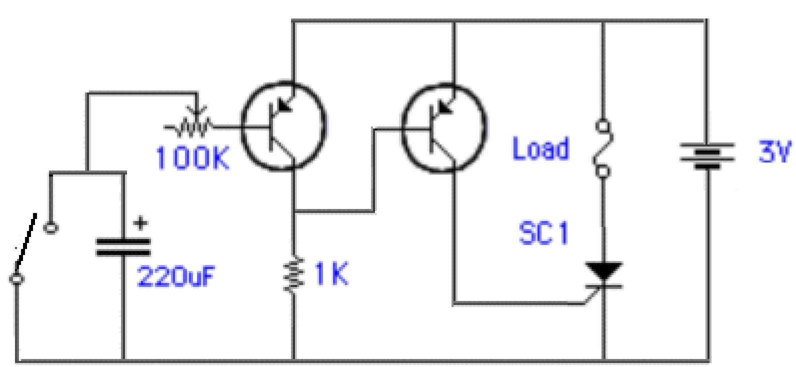
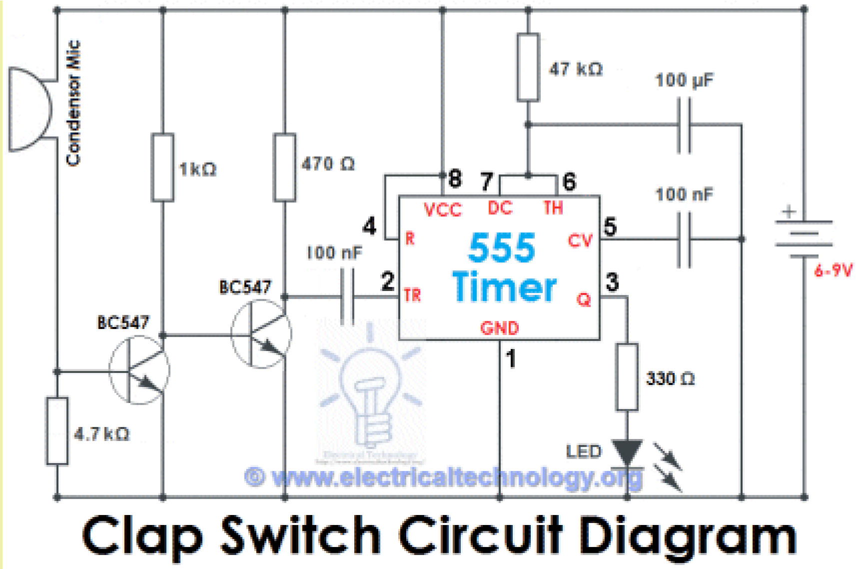


Fig. 1 - Circuit Schematic for Timer



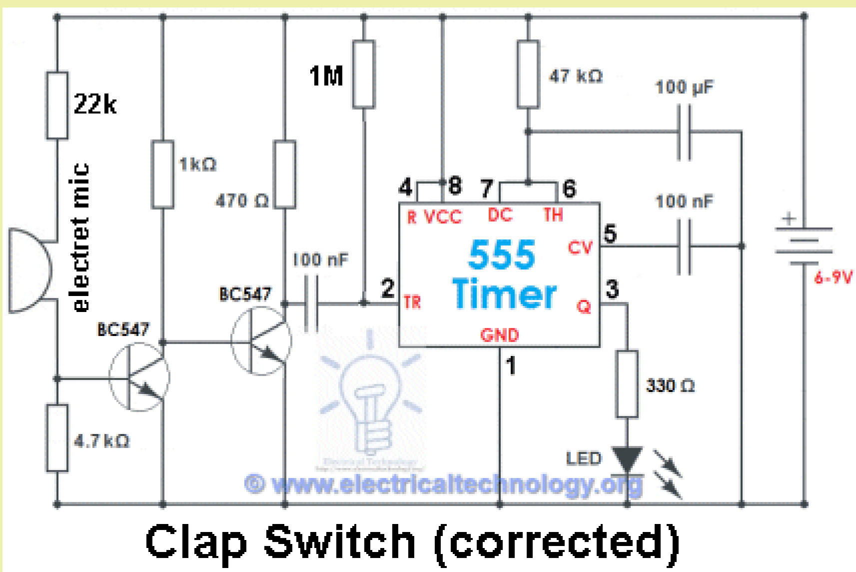
The original circuit is so messy that I could not work out how it worked. It has been re-drawn and now you can see the mistakes. The 100k pot can be turned to zero ohms and when the switch is pressed, the transistor will be damaged. The SCR is IRF530n and its gate voltage is about 2v to 4v. It may work at 3v.
The IRF530n is actually a POWER MOSFET and needs 2v to 4v to turn on so it is not really suitable for this circuit.
The main point at the moment is to draw a circuit so you can how it works.
Once you see how it works, you can see the gate voltage of the SCR (or MOSFET) must be less than 2.5v for the device you are selecting as this is the maximum voltage available.

CLAP SWITCH - another Clap Switch !!



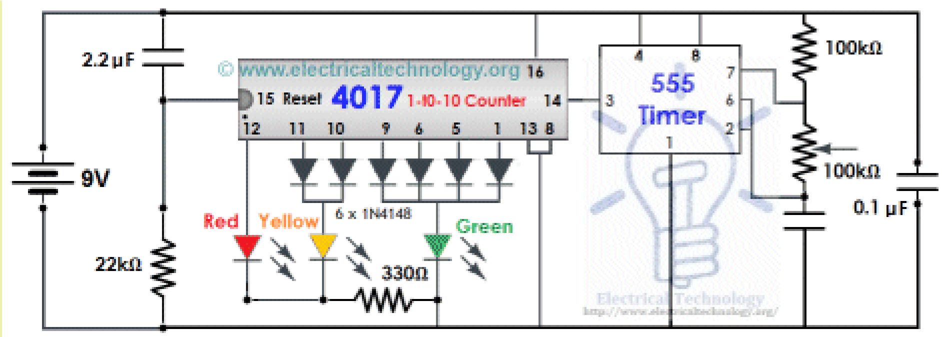
This is a badly designed circuit because the mic does not have a load resistor and it is effectively across the 6v to 9v supply.
Pin 2 is floating and this pin has a high impedance. The voltage on the pin is unknown.

Wasim Khan from http://www.electricaltechnology.org emailed me to say he didn't have a clue what I was talking about, so here is the corrected circuit:



The electret mic needs an operating current of less than 1mA and the original circuit did not have a load resistor to limit the current.
Pin 2 in the original circuit is floating and although the 555 may work, pin 2 must be held above 33% of rail voltage so it does not activate the chip until required.

TRAFFIC LIGHTS



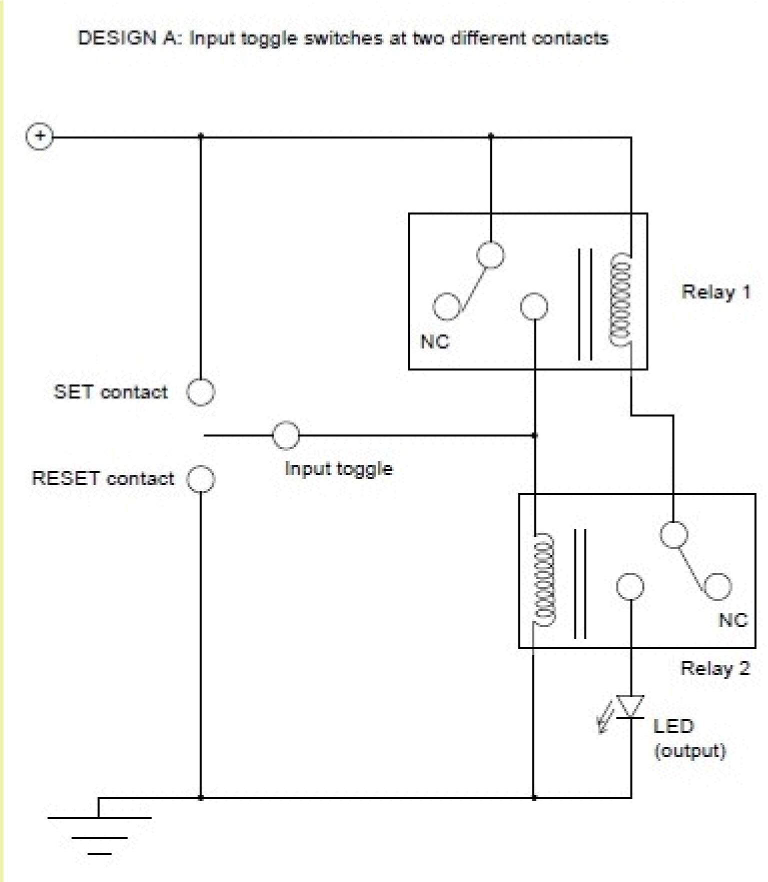
Another badly designed circuit from the same website.
The 2u2 has no polarity. The timing capacitor has no value. The 100k pot does not have the wiper connected. The green LED does not have a dropper resistor. The sequence for the 4017 is 3 2 4 7 10 1 5 6 9 11. Pin 12 is HIGH during the time when 3 2 4 7 are HIGH. The LED sequence is correct.

Here is a comment from a reader:

Hi Colin
I think it is fantastic that badly designed circuits made by others and put on the internet, are shown for their errors. It is a great teaching source for those who want to learn about the in's & outs of electronics, in such a practical & clear way.
Yes, it can also prevent one from building a circuit, only to find out that it does not work.
Keep up the great work and website.

Regards
Craig Adkins
PC Hardware & Software Support

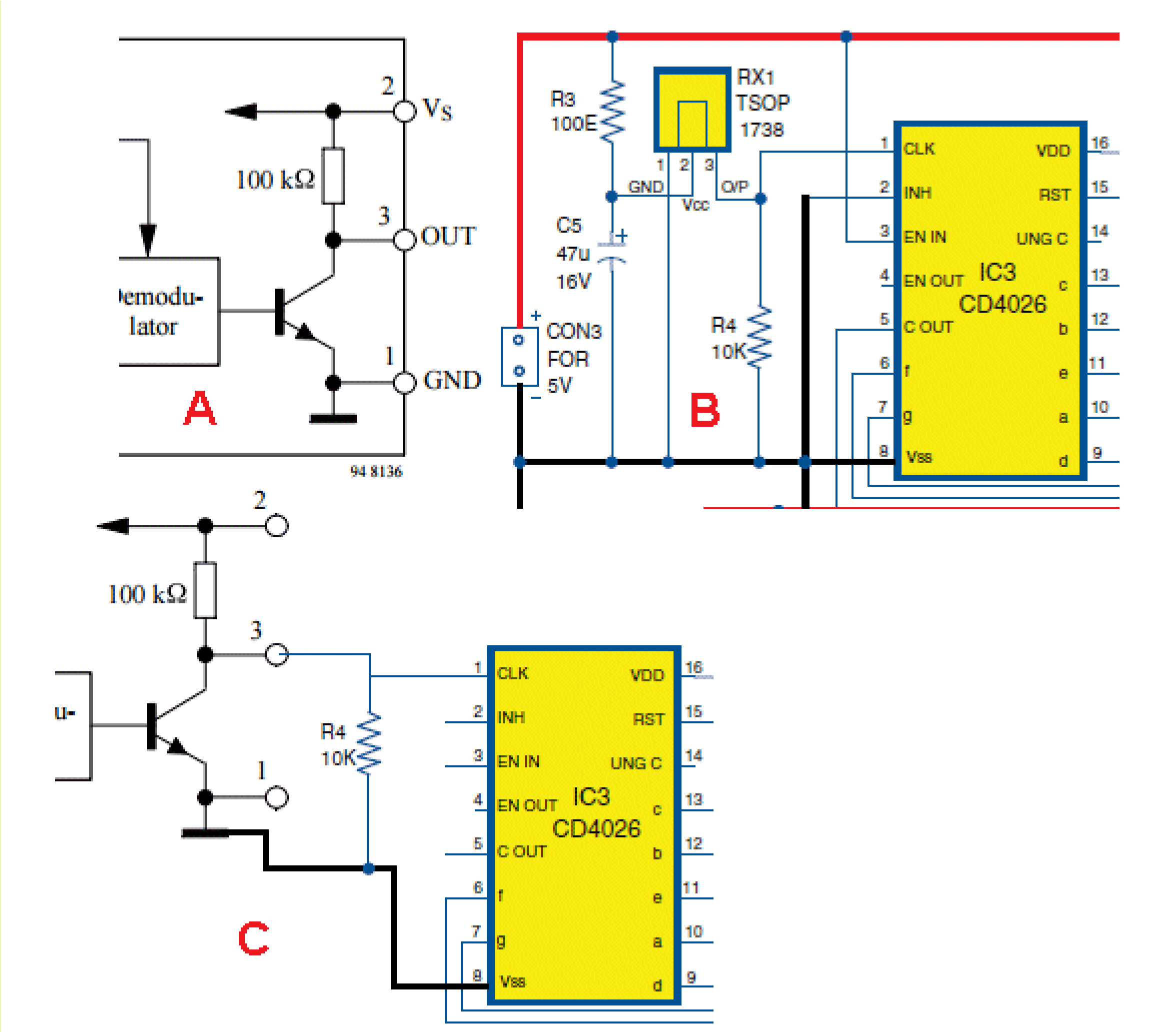
TOGGLE



Here's a SET / RESET circuit made with relays.
The LED is turned off by SHORTING ACROSS THE POWER SUPPLY !!!!

TSOP 1738

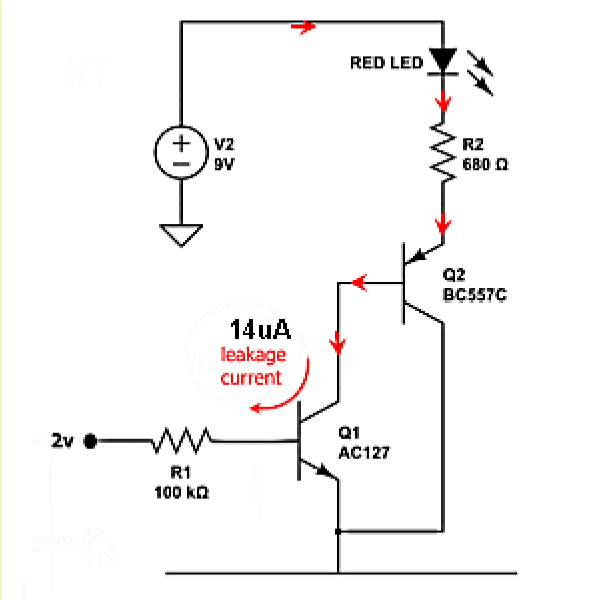
Here's another faulty design from **Electronics For You** May 2016. They never test the circuits. That's why most of them don't work.

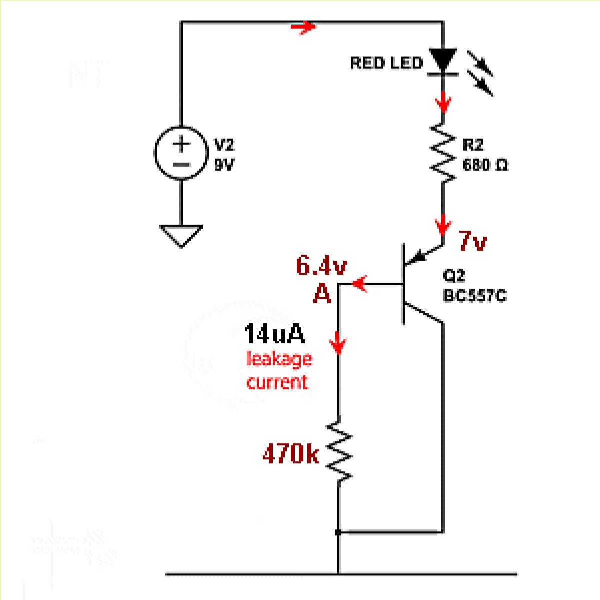


The original circuit is shown in B and it looks to be ok until you see the 100k resistor inside the TSOP 1738 and the 10k on the main circuit.
These two resistors form a voltage divider and when the transistor is not activated, the maximum voltage will only rise to 10% of rail voltage. The voltage will go from 0% to 10%
This will not allow the chip to clock. The circuit WILL NOT WORK.

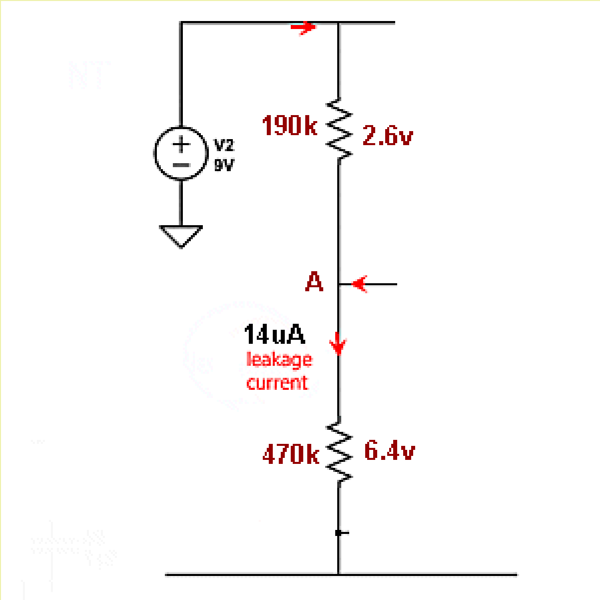
LEAKAGE

Here's a problem with LEAKAGE.
This is when a very small current flows through a transistor (or any other component) and this current cannot be reduced or stopped.
See more on LEAKAGE in The Transistor Amplifier P2 article.
In the following example, Q1 is a leaky transistor. It can be any type of transistor and although the leakage current flows via the collector-base junction, we can assume the transistor is exactly the same as a 470k resistor.

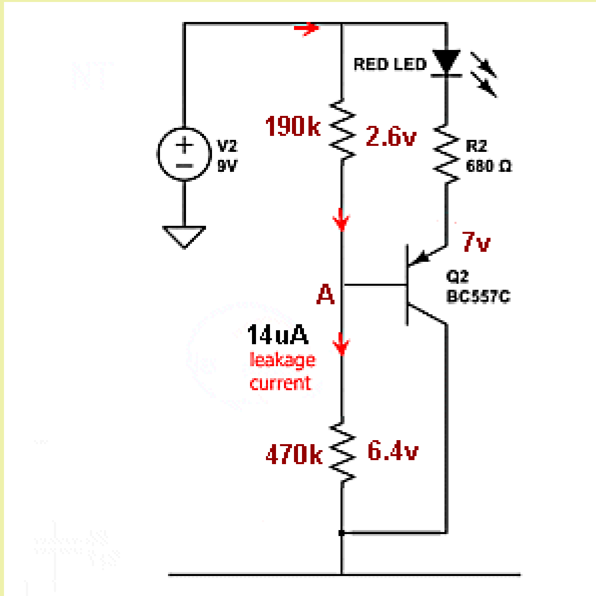


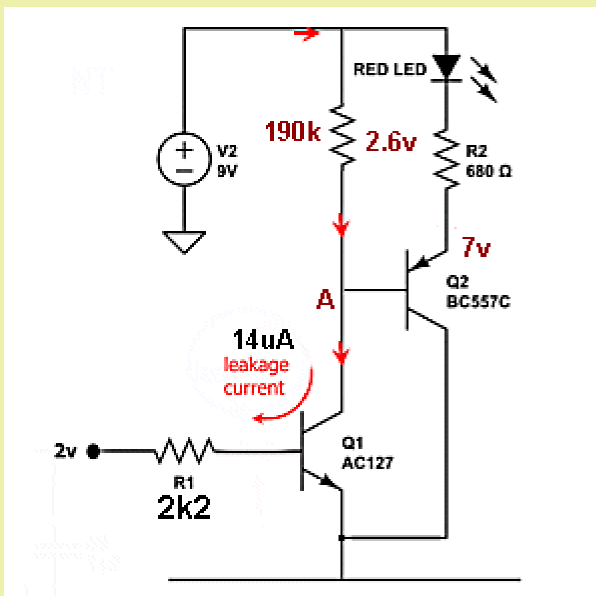


If we place a resistor from the supply to point A on the diagram, we will create a voltage divider and 6.4v will be at point A.



The base of Q2 will see a voltage of 6.4v but no current will flow in the base and thus the LED will not be illuminated.

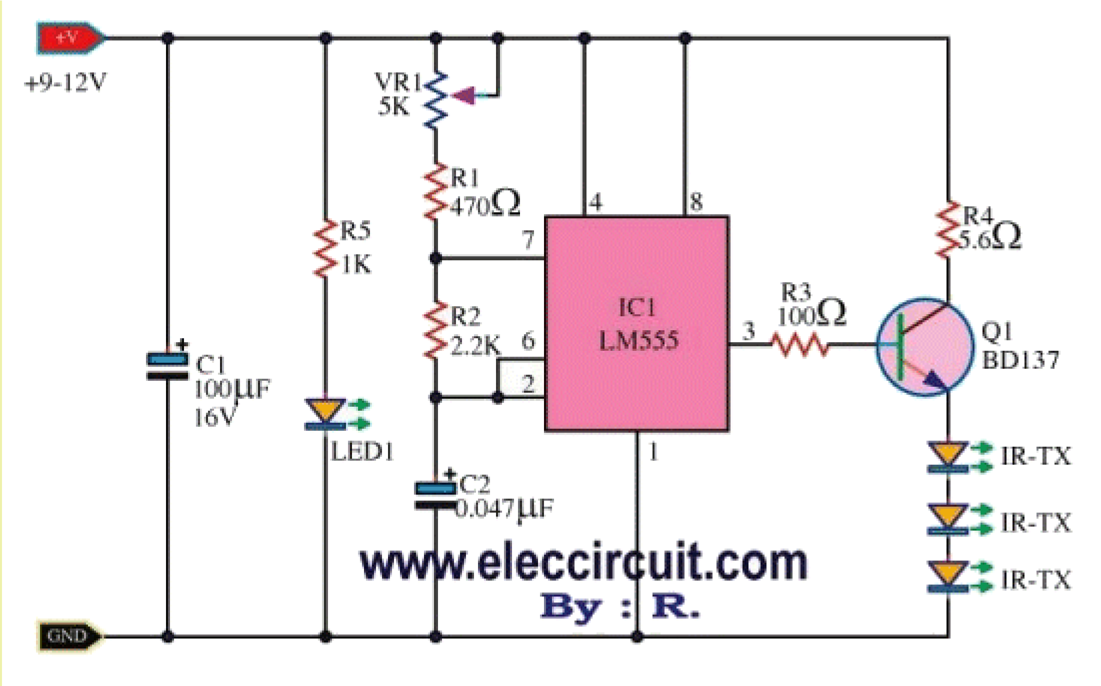




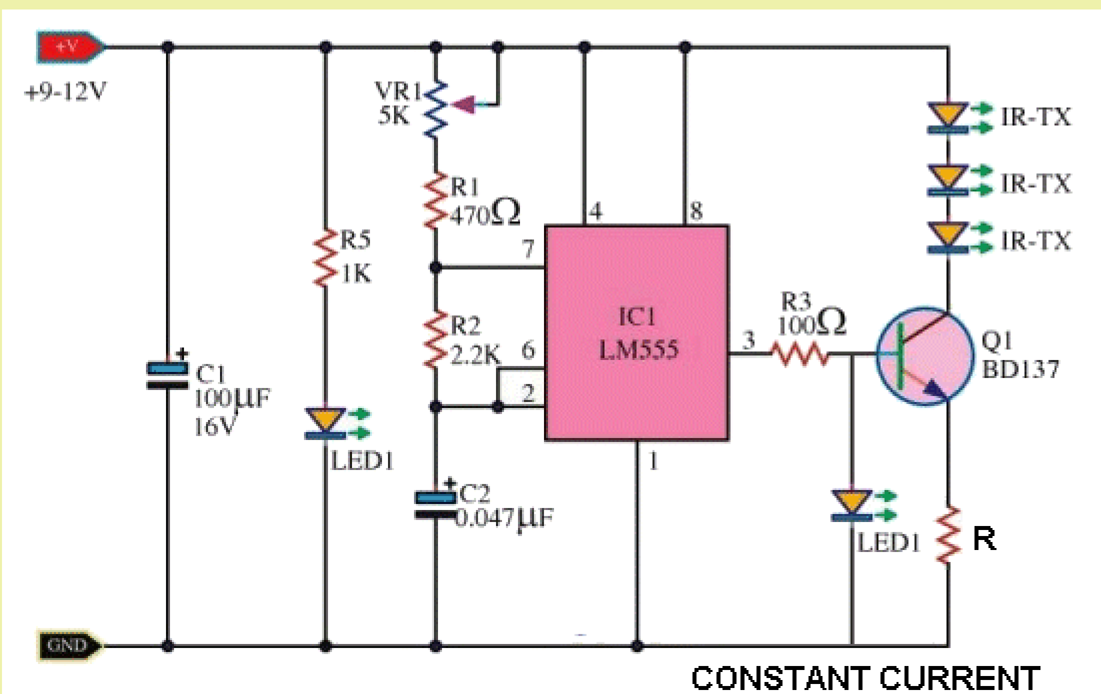
The leakage comes via the 190k resistor and the LED is not turned on.
The base resistor for the first transistor will have to be reduced to 2k2 so the transistor will turn OFF when the input voltage is zero. Silicon transistors are very leaky and should NOT be used in this type of circuit.

IR LED

Here's a dangerous circuit:

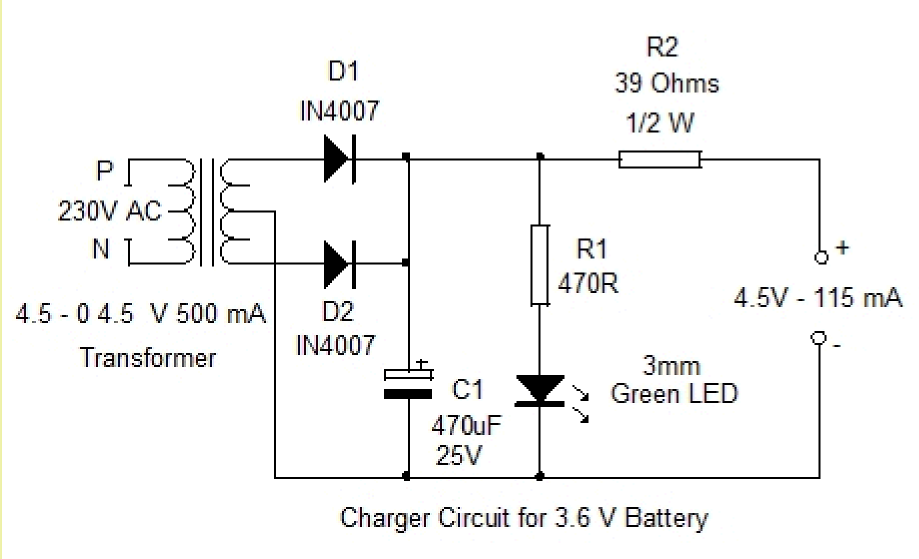


The voltage drop across each Infrared LED is about 1.5v to 1.9v.
This produces a maximum of 6v.
When the transistor is turned ON, the voltage across the 5R6 can be up to 6v. The current through the 5R6 can be as high as 6/5.6 = 1amp !! Most IR LEDs are designed for 30mA to 100mA. They will be damaged in this circuit.
By adding 1 more component, the output driver transistor can be converted into a CONSTANT CURRENT device and the current set by the value of R to suit the IR LEDs and deliver the same current for a supply voltage from less than 9v to 12v or slightly more.



CHARGER

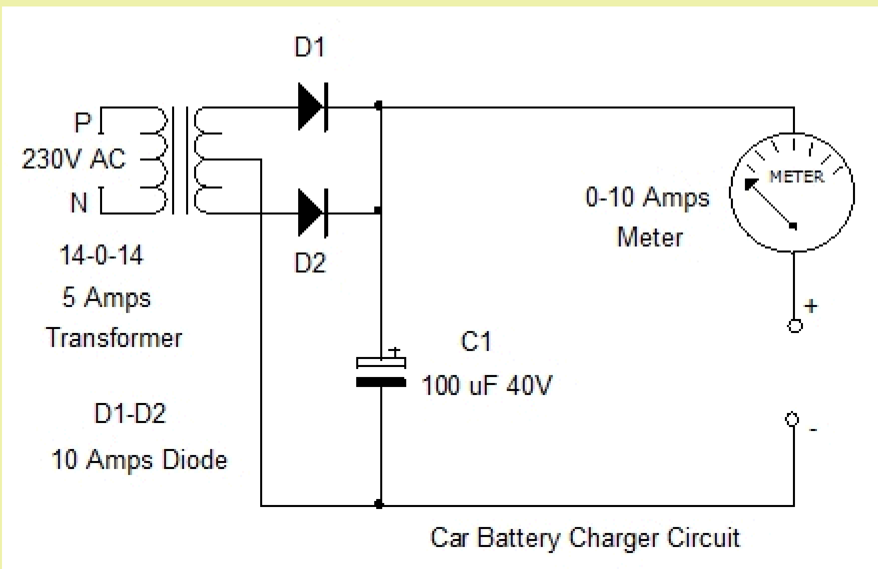
Here's a circuit that will not work:



The transformer will produce 4.5v x 1.414 = 6.3v minus 0.7v drop across the diode = 5.6v
The current through the 39R will be 5.6v - 4.5v = 1.1v / 39 = 28mA.

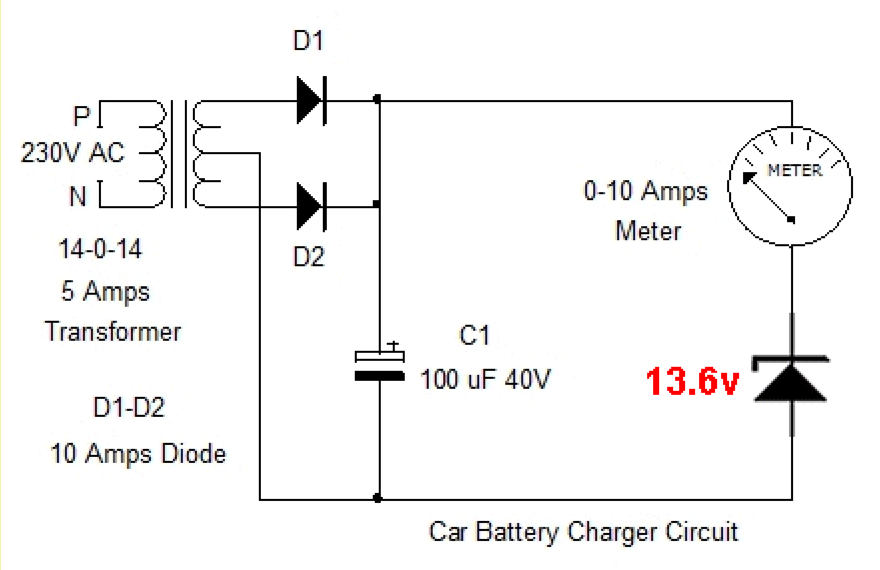
The IDIOT "**Professor D Mohankumar**" said the maximum current through the 39R will be 115mA due to 4.5v / 39 = 115mA. BUT the current is due to the VOLTAGE DROP ACROSS THE RESISTOR - the voltage that will be across the resistor when the battery is included in the circuit and this voltage will be 1.1v NOT 4.5v !!!!!!
How can you become a "**Professor**" of electronics in **INDIA** when you don't understand the simplest electrical circuit ????
What about his students ??? How are they going to learn electronics ???????

Here's another DANGEROUS circuit from "**Professor D Mohankumar:**"



You cannot use an ordinary transformer to charge a battery.
A battery-charger transformer is specially designed to produce the EXACT output voltage for a 6v, 12v or 24v battery.
A fully charged 12v battery has a terminal voltage of 13.6v and the peak voltage from the winding must not be greater than 13.6v plus the voltage drop across the diode plus the small voltage drop across the ammeter and the leads.
When the battery reaches 13.6v, we want a small "trickle charge" to enter the battery of about 50mA to 300mA, depending on the size of the battery.
We also want the battery-charger transformer to deliver say 5 amps when the battery is less than 13.6v and we specially want the current to be 5 amps when the battery is 12.6v
In other words we need the current to rise enormously, when the voltage is below 13.6v and taper off to almost nothing when above 13.6v.

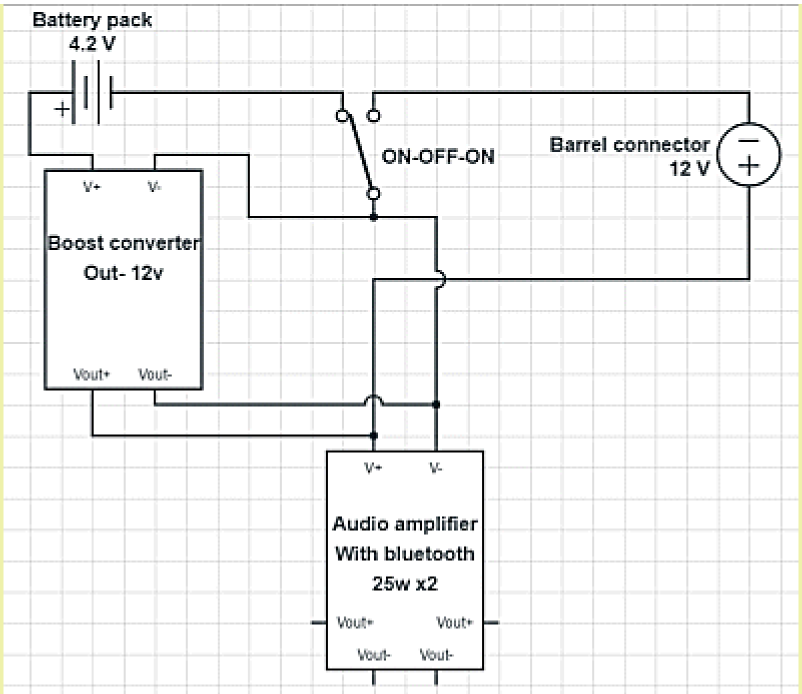
This can only be done with a low-impedance transformer (low-impedance winding) and explaining this is very technical and will not be covered at the moment.
A normal 14v - 0v -14v transformer will produce a peak of 14v x 1.4 = 19.6v and will deliver about 19v to the battery.
This voltage is TOO HIGH and two things will happen.



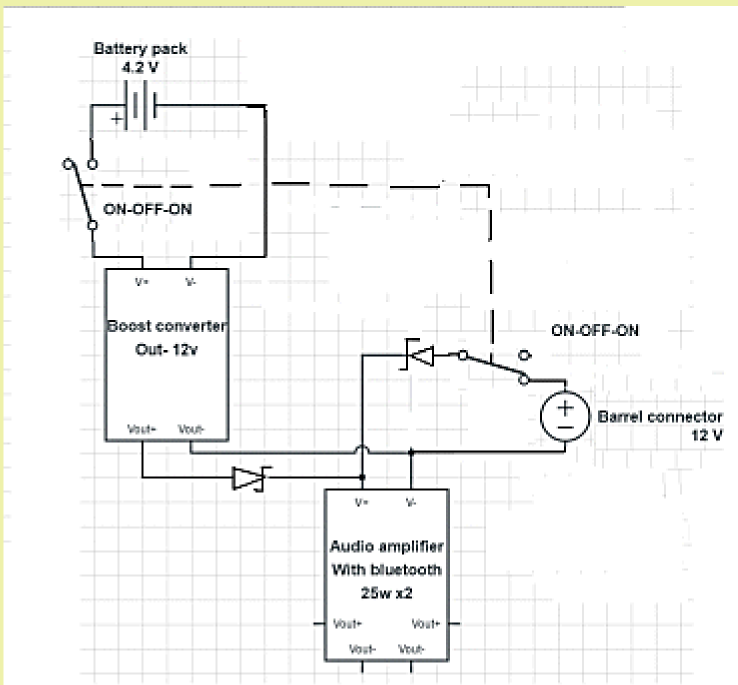
Firstly, the current will be greater than 5amps and the transformer will BURN OUT.
If it does not burn out, the current will continue after the battery is fully charged and the water in the cells will "boil off" and the battery will "dry out."

A battery is not like a normal resistive load. When it reaches 13.6v, it is just like a ZENER DIODE.
We know how a zener diode works. When its specified voltage is reached, the voltage across it does not rise any further and all the current flows through the diode.
This is exactly what happens with the battery.
We have a transformer producing 19v and a zener allowing 13.6v to appear across it. We have a CLASH OF VOLTAGES. During each cycle, no current flows until the waveform reaches about 14.5v and then the output voltage see a SHORT CIRCUIT. A normal short-circuit starts at 0v output and will burn out the transformer. This time it starts a 14.5v and continues until the output voltage reaches a peak (in our case, about 19.6v). This part of the waveform will deliver an enormous current and will be enough to over-heat the transformer.

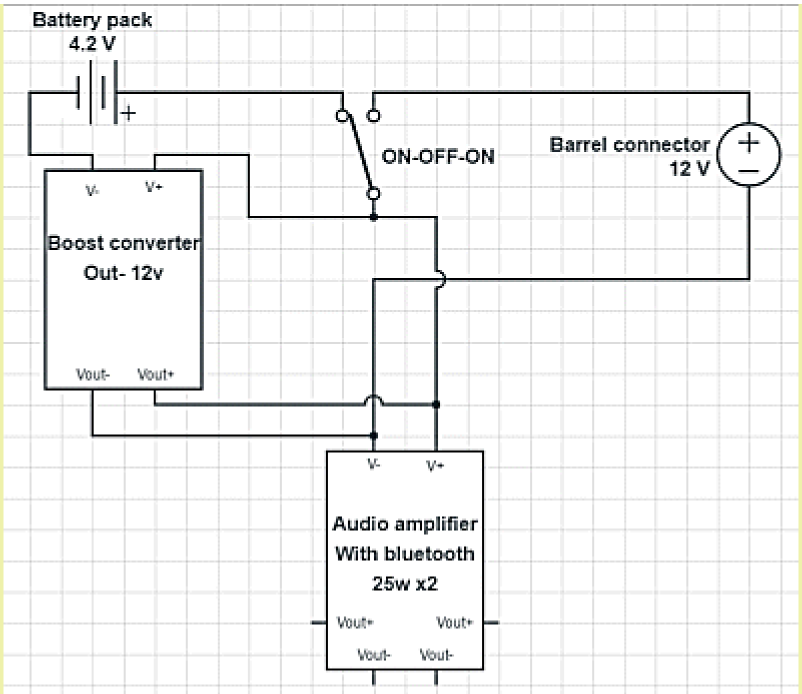
A poster on an electronics forum asked about his circuit.
The circuit is well-deigned and very simple:



A "electronics engineer" came up with an "improvement:"

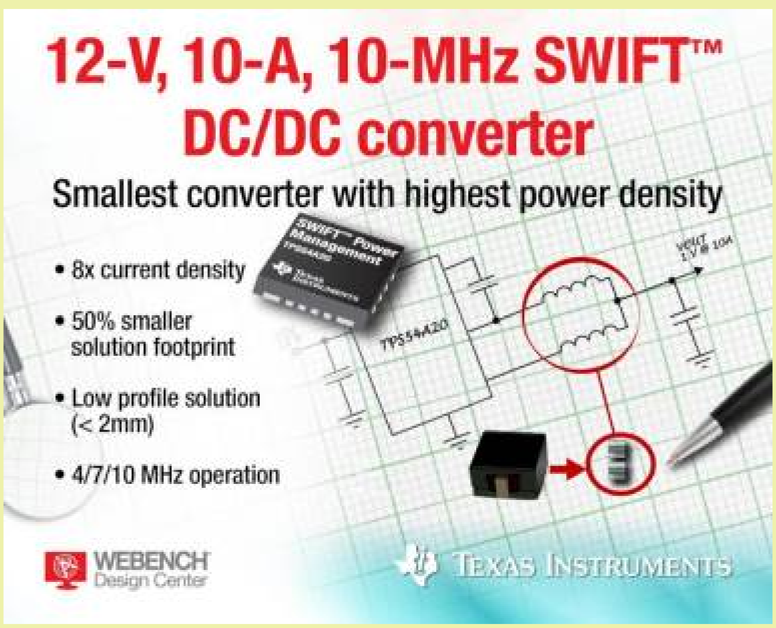


The "improvement" is more complex, uses a larger switch and 2 extra diodes.
This is just one more example of the incompetence of "electronics persons" in designing a simple circuit.
You will find this flows through all the electronics forums.
So many of the "electronics wizards" have little or no understanding of the basics of electronics. They may be able to master a CAD package, use circuit analysis software but when it comes to intelligent-designing, they "fall off the boat."
All you have to do is change the connections and the first circuit can be used !!! You don't need a DPDT switch and two diodes !!!!



That's why a Masters in Electronics from a University doesn't always help.
Most Boost Converters have the input isolated from the output via a high-frequency transformer, and this must be the case for this circuit to work as the negative output of the converter will be be below 0v. (taking the negative of the battery as a reference 0v).

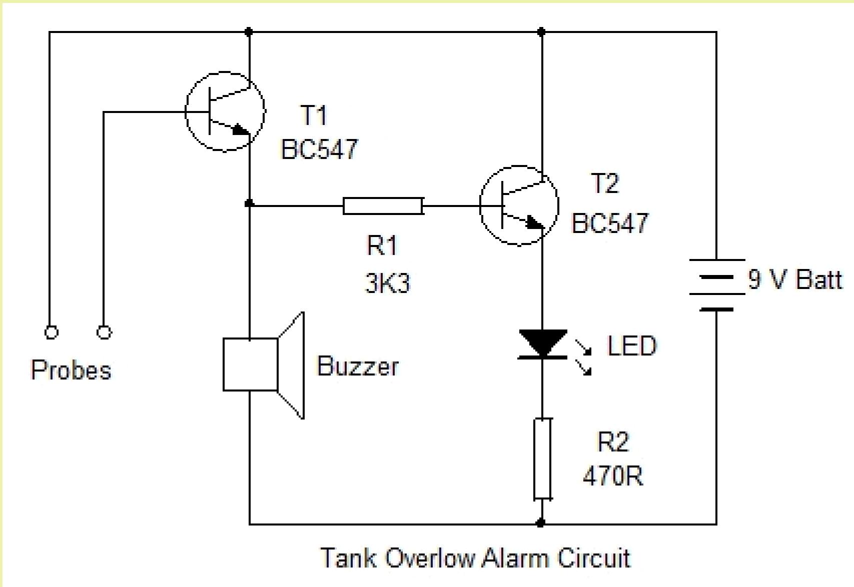
POOF!!!



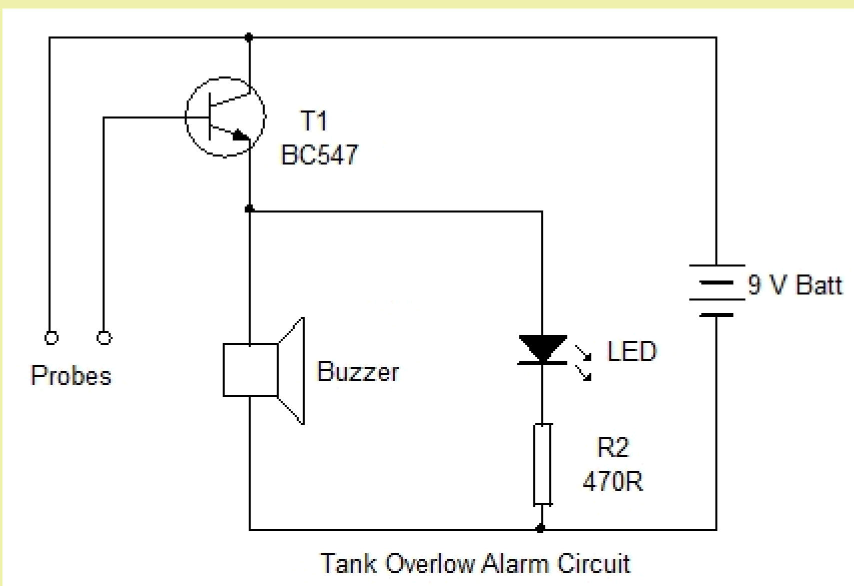
There are hundreds of new and exciting chips and products being developed and reviewed on the web, but you have to be very careful about including anything in your designs.
Many of these new devices are not stocked by any supplier and sometimes you have to buy a whole roll (3,000 pieces) to get your order fulfilled. Take the PR4401 inverter chip to drive a white LED from 1.5v.
It is worth 5 cents but costs 70 cents and the supplier shows a stock of 994 pieces aster 3 years !!! He has sold 6 pieces !!
Most of these recently developed chips are too expensive and and will be deleted from inventory after a few years.
When designing a product, you have to think of a life-span of 20 years. Many of the items I produce are 25 years old and they can still be produced because I have used readily-available components.
All the kits using special parts have been deleted as the chips are no longer produced.

If you are not careful, this can cripple your business.
A new product or chip may look tempting but others will see the item too and if sales are less than expected, you will see the product on eBay for $1.00. Just look at the Arduino modules. A $10.00 product is now $2.00!!
Lots of these new chips will disappear . . . . POOF!!!

Here's another poorly-designed circuit from "Professor Mohan Kumar:"



The second transistor is not needed. If the first transistor is capable of delivering 30mA for the buzzer, it will also be able to illuminate the LED:



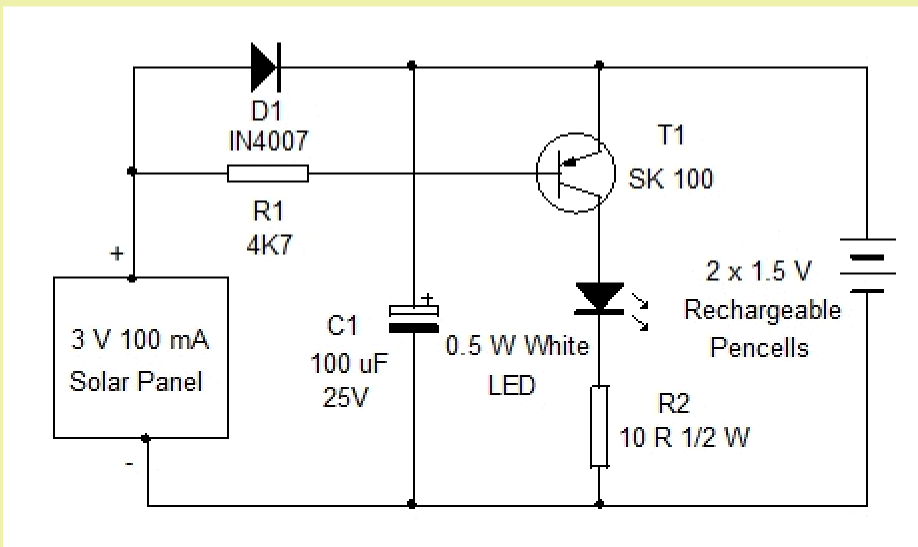
All these points, discussions, criticisms are referred to as "second-order understanding."
Second-order understanding is when you take a circuit and see if it can be simplified or improved so someone with greater understanding cannot criticise it.
You will never find this concept in any text book.
It's wonderful to churn out mathematical formulae but an equation will not design a circuit for you.
It's like a person buying a CRO to design a circuit by seeing the waveforms.
You have to know which components to change to get greater amplitude or higher frequency or shorter mark-space ratio. You have to know what the waveform will look like before viewing it, otherwise you will be "tricked" by what you see.
The same with mathematical results.
You must write down what the result should be and see if the equation conforms your understanding.
The same applies to the circuit above.

If the first transistor can deliver 30mA to the buzzer, why not include the LED ???
It's simple "electronic understanding."

There is a constant stream of new produces and chips on the web but you have to be careful.
Most of these are very exotic and perform wonderful tasks, but they are very expensive and very few suppliers stock them. On top of this, there is no guarantee that the item will still be available in 3 years time.
The other big problem is copyright. if you design something that takes off and has a long=term future, you will find others will copy the idea and use cheaper components.
No only will they under-cut you but your copyright and/or patent will be worthless.
Chasing up an infringement will cost $50,000 and the chance of finding the manufacturer will be zero. Look at all the clones that come onto the market after a few weeks.
People work 25 hours a day to copy things and they generally have a much bigger distribution market. They will out-strip you 10-fold
Here are t he two points to note:
Don't waste your effort, money and stock in exotic components.
Don't waste time in paying for a patent or registered design. You are only alerting the copiers to your idea and giving them 4 weeks "head-start."

SOLAR LIGHT

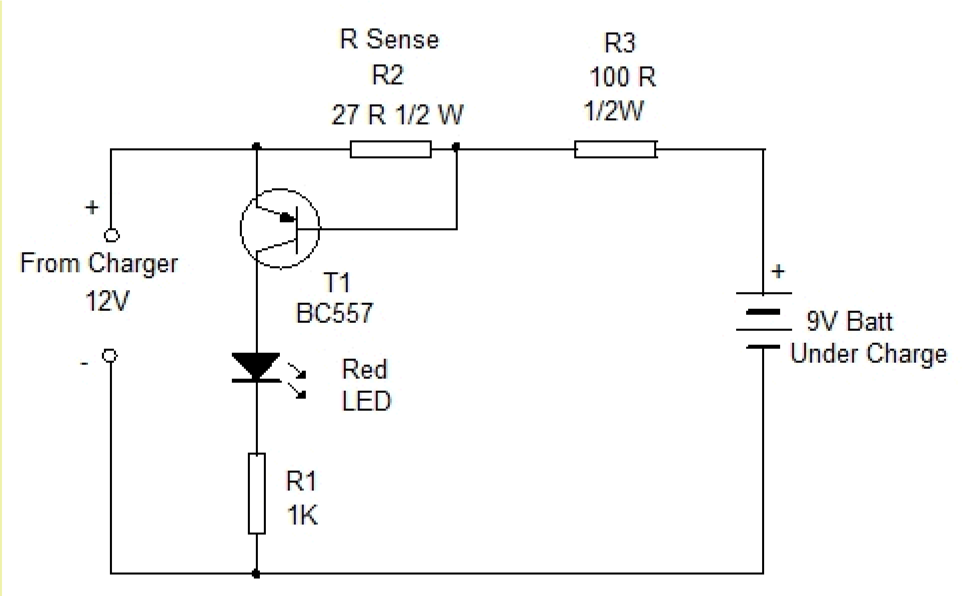
Here's more rubbish from "professor" Mohan Kumar:



The circuit will NOT work. A 3v solar cell through a diode will no charge a 3v battery. The "floating voltage" produced by 3v battery when it is being charged is nearly 4v and you need a voltage higher than this to charge it.
Secondly, a white LED has a characteristic voltage across it of between 3.2v and 3.6v.
The 3v battery will be less than 3v via the transistor and the LED will NEVER illuminate. Just another untried, untested, junk circuit from an Indian Professor.
What is the purpose of the 100u electrolytic??? It does nothing.
He has been informed of his mistakes for over 18 months and he still keeps adding more junk to the web each week. When will he learn??
NEVER !!!!!

CHARGE CONTROLLER

Here's more rubbish from "professor" Mohan Kumar:



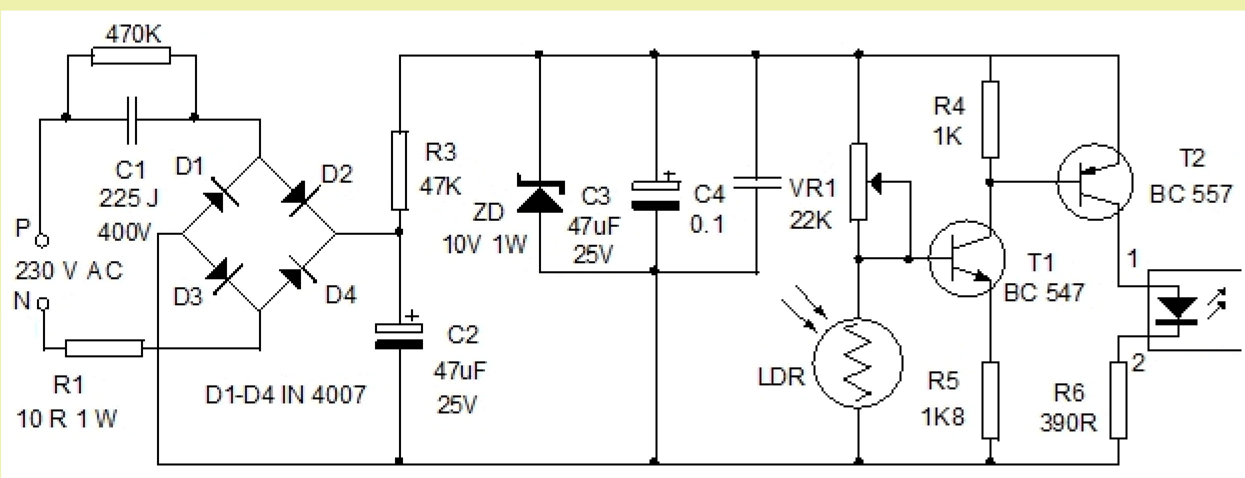
Mohan Kumar says:
The charging current will be:
12V / 127 = 0.094 Amps or 94 mA.

This is NOT TRUE.
The charging current will be: THE VOLTAGE ACROSS THE TWO RESISTORS DIVIDED BY 127 OHMS.

The voltage across the resistors will be 12v minus the voltage produced by the 9v battery when it is being charged.
This will develop a "Charging Voltage" of at least 10 volts.
This means the voltage across the 127 ohms will be 2v AND NOT 12v.
The maximum charging current will be: 2 / 127 = 15mA.
The maximum voltage across the 27 ohm resistor will be 0.4v and the transistor will never turn on.
Another untried, untested circuit for this Indian Professor."

NIGHT LIGHT

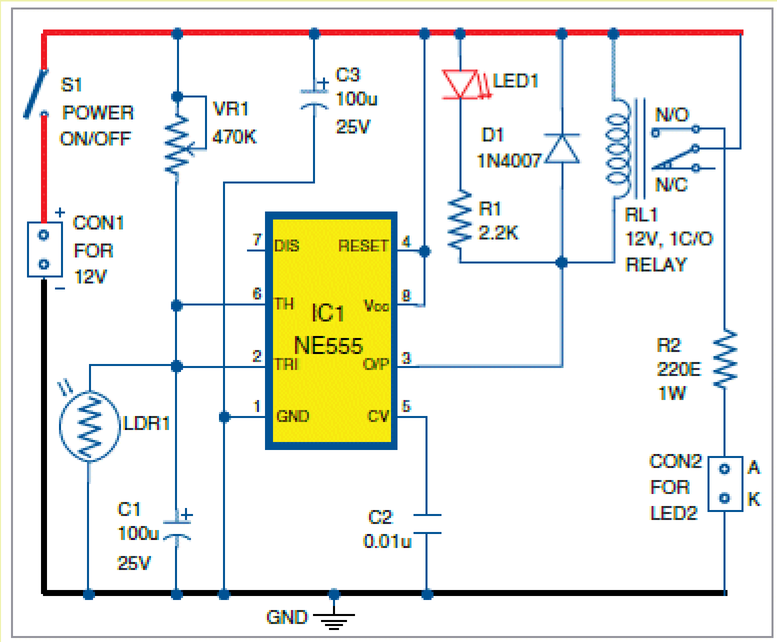
Here's another disaster from "professor" Mohan Kumar:



This time we are talking about a 240v LIVE circuit. The 225 will pass up to 150mA and this will cause over 325v to be developed across the 47k resistor. The 47u 25v electro will BLOW UP!!!
The current required by the circuit is only about 10mA to illuminate the LED so the 225 capacitor should be 220n (224).
The 47k R3 should be 100R.
To turn OFF the circuit, the resistance of the LDR must be reduced to 1,000 ohms because the base voltage of T1 must be 0.5v to turn the transistor OFF. This is created by the voltage divider of the LDR and 22k pot.

The 1k8 resistor will simply slow down the change from OFF to ON and ON to OFF. It's not a good place to put a resistor.

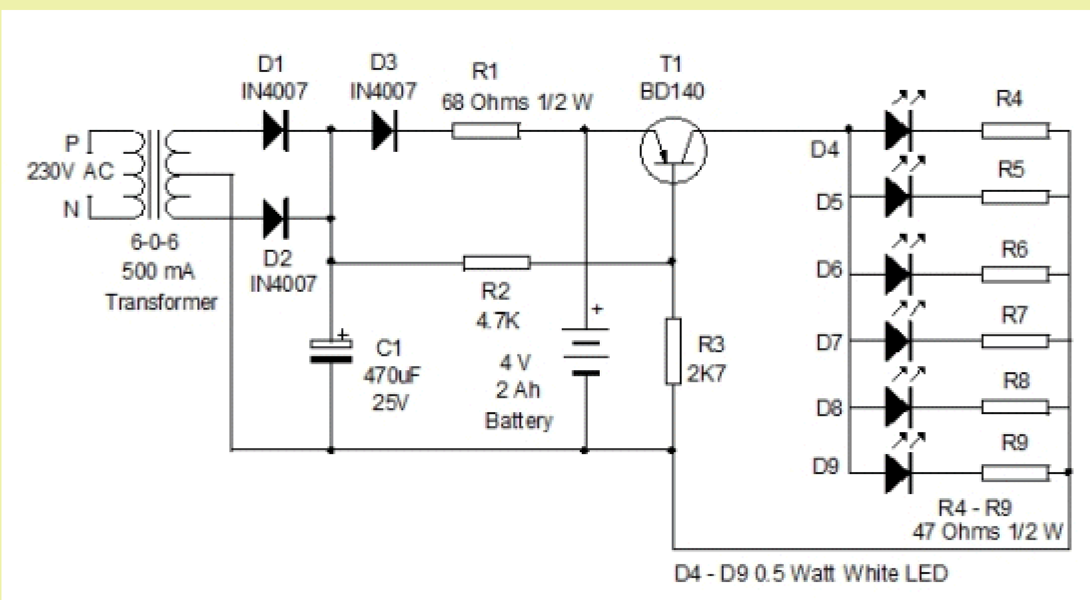
BOAT LIGHT



When ever you have a potentiometer in a circuit, make sure it does not damage any of the components if it is turned fully clockwise.
In the circuit above, the LDR will see full rail voltage when the pot is turned and if the LDR is in bright sunlight, its resistance will be very low. It may get damaged.

EMERGENCY LIGHT

Here's another disaster from "professor" Mohan Kumar:

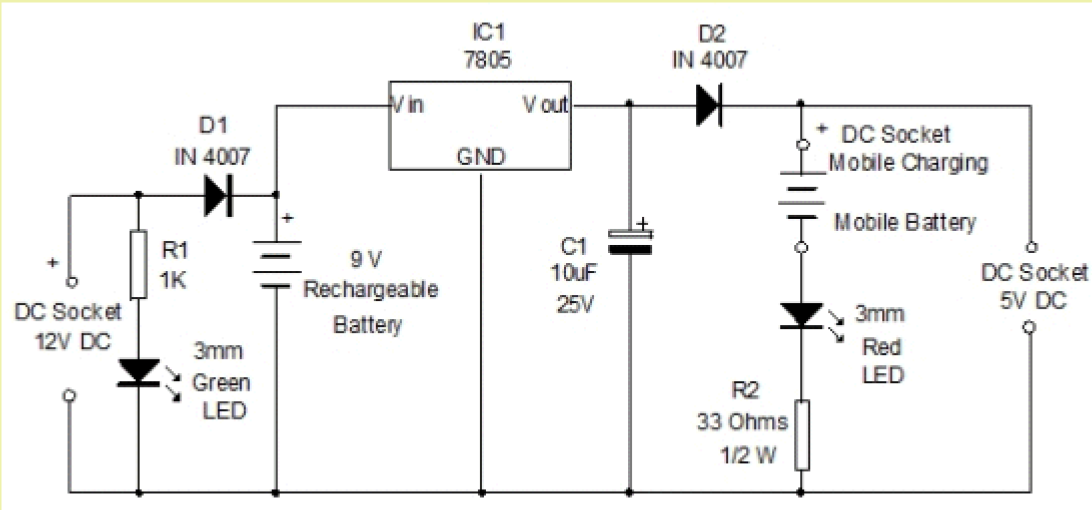


He doesn't test anything. He does not understand electronics AT ALL and yet he still keeps adding his faulty circuits to the web.
This circuit does not work.
The gain for the BD140 is up to 250, but this is in a test circuit and pulsed at a duty cycle of 2%. This is totally unrealistic and when the transistor is placed in a real circuit, the gain is less than 100.

When the transistor is turned on via the 2k7, the base current will be 3.4/2700 = 1.2mA. This means the maximum collector current will be 120mA.
The characteristic voltage drop across a white LED is a minimum of 3.2v and this allows 4v - 0.2v across the emitter-collector junction - 3.2v across the LED = 0.6v across the 47R resistor.
The current through the 47R will be 12mA.
Why use 500milliwatt LEDs ???
Most white LEDs have a characteristic drop of 3.4v to 3.6v and this circuit will not work AT ALL.

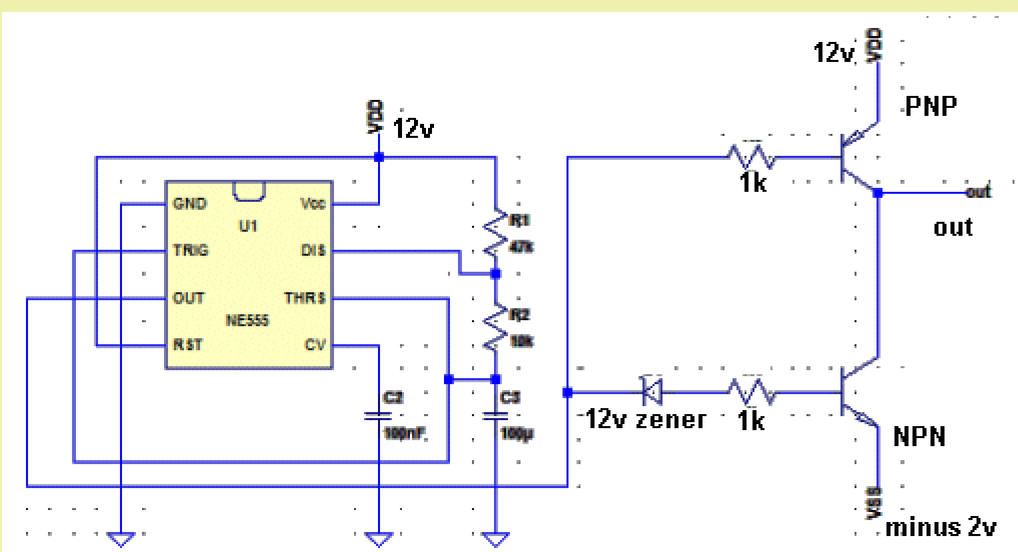
PHONE CHARGER

Here's another disaster from "professor" Mohan Kumar:



There is no current-limiting resistor between the 12v supply and 9v rechargeable battery. The battery will BLOW UP !!!
There is no switch between the 9v battery and regulator. The regulator takes 10mA all the time and will flatten the battery.
The output of the regulator is 5v minus 0.7v = 4.3v. It is NOT 5v.
The mobile battery will see 4.3v minus the voltage across the red LED (1.7v) = 2.6v. The mobile battery will NEVER get charged.
I don't know how Mohan Kumar became a "Professor." It just gives teachers a bad name. None of his circuits work and none have been tested. He says I don't know what I am talking about. Let the 22 million readers of Talking Electronics website be the judge.

Here's a 555 circuit from an "electronics engineer" in a forum:



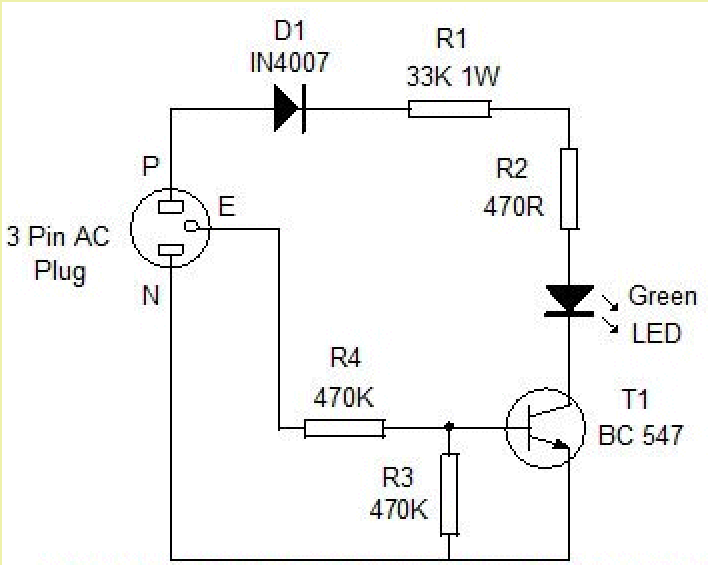
The output is required to deliver 1 amp.
Two faults with the circuit.
The output of the 555 does not rise to 11.4v to turn OFF the PNP transistor. It rises to about 10.3v.
When the output is HIGH the voltage across the 1k base resistor for the NPN transistor will be almost zero, even though the emitter is minus 2v compared with the 0v of the 555. The NPN transistor will never turn ON !!!
That's why you have to build a circuit and not rely on a simulation package.

WHY DIODES AND BRIDGES FAIL

Diodes and bridges fail when the current increases.
The main problem is this:
A diode rated at 1 amp is really a 700mA diode. The voltage-drop across a 1 amp diode at 700mA is 750mV. This gives a wattage dissipation of about 0.5 watts.
When the current increases to 1 amp, the voltage across the junction rises to 1.1v to 1.2v. This fact is never mentioned anywhere and that's why you have to test a circuit and see what is really happening.
At 1 amp, the diode is dissipating more than 1 watt and if the printed circuit board does not have large solder-lands, the diode will eventually fail.
The same reasoning applies to bridges.
When a bridge is connected to the output of a transformer, the waveform is sinusoidal (AC) and as it rises to a peak, that's when a very high current flows, because as the voltage falls, very little current flows. To get an average of say 1 amp, the peaks must be a lot more than 1 amp.
During the peak, the current might be 3 amp and the voltage across the diode 1.2v. This is 3.6 watts for a short period of time.   Now you can see why a diode can fail.

EARTH

Here's another disaster from "professor" Mohan Kumar:



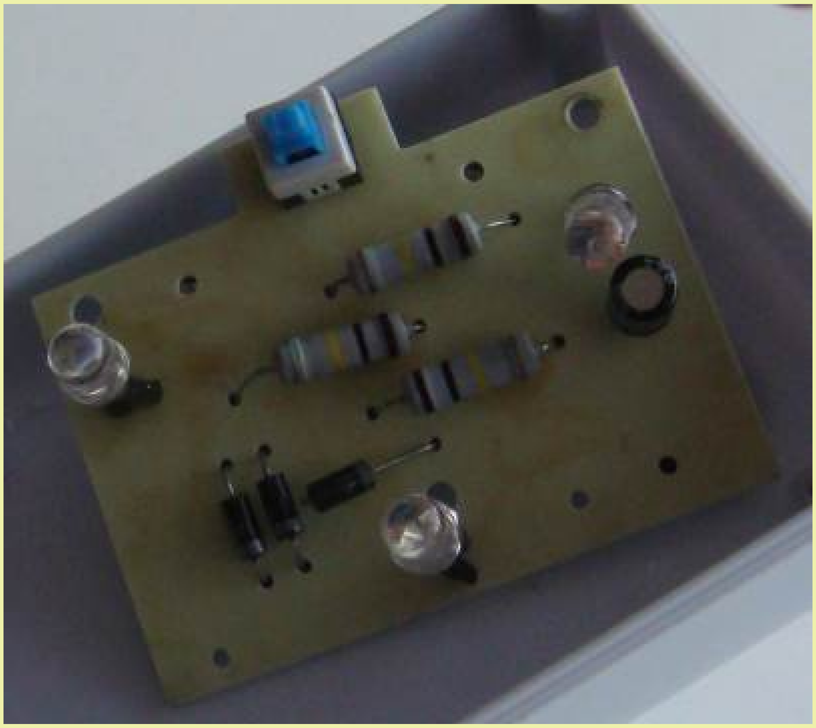
Mohan Kumar says:
When the wiring is proper, a potential difference develops between the Neutral and Earth lines and T1 turns on to light the LED.

This is INCORRECT.
Plugging this circuit into the wall socket will NOT illuminate the LED because the Earth and Neutral will be at the same potential.
At NO TIME will the earth be at a higher potential then the Neutral.
I am amazed that Mohan Kumar is still alive, with his mis-understanding of the mains.
How can he teach this RUBBISH to his students ???

Here's fraud from AliExpress

[Ultrasonic Pest Repeller Electronic Pest Control Rodent Mouse Anti Mosquito Insect EU US Plug ABS 100-240V]

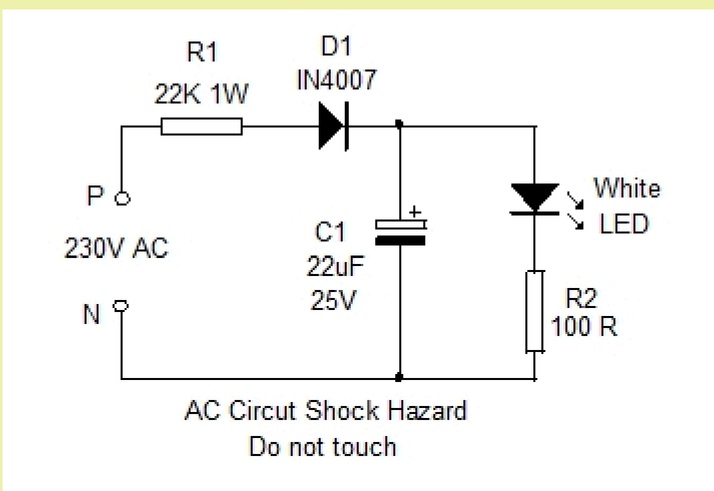
Here's what's inside:



The item has NO ultrasonic components. The LEDs simply illuminate !!!!
I am having enormous trouble getting a refund. That's because Alibaba does not have paypal. They debit your credit card. Another FRAUD from Alibaba.

R2 ????

Here's another circuit from "professor" Mohan Kumar:



What is the purpose of R2 ???? It does nothing. That's why you need electronics experience before putting this type of rubbish on the web.

The following comes from T.K. Hareendran.

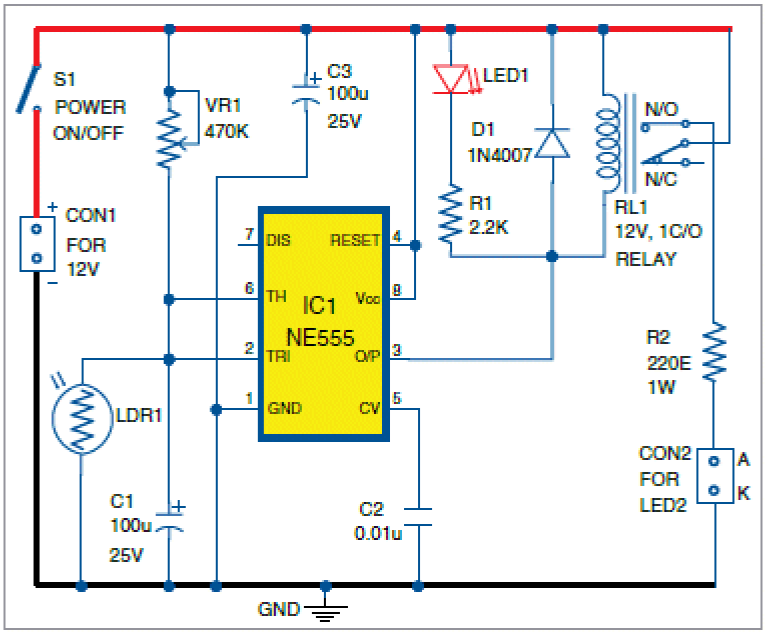


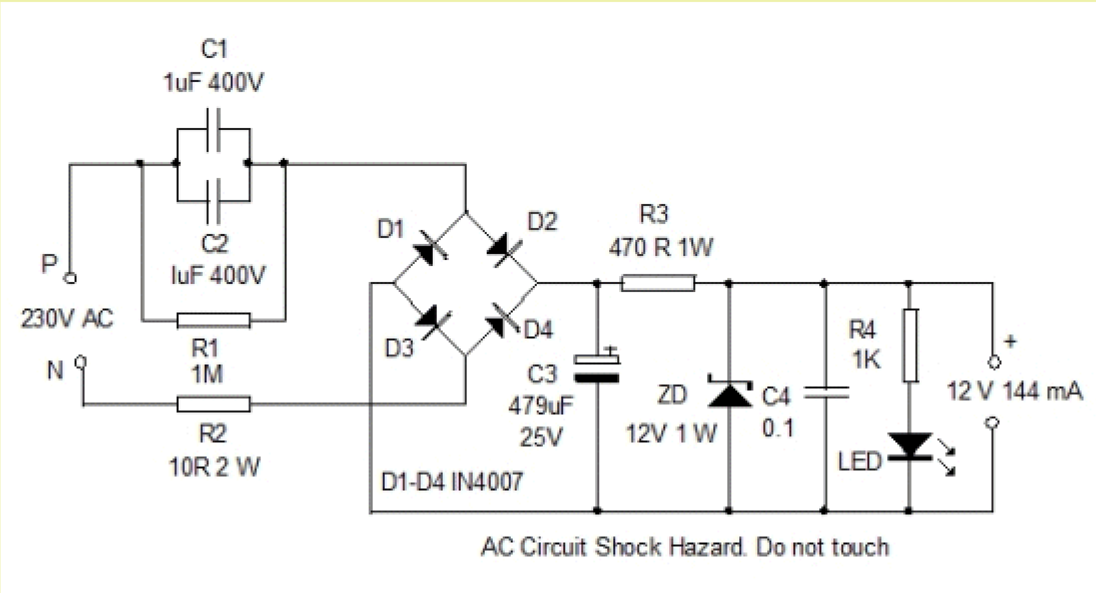
Fig. 3: Circuit diagram of the anchor light

Note that switching threshold is determined by a 470k potentiometer (VR1) that causes the output to toggle with the preset threshold values. The light source (LED2) automatically switches on when it gets dark and switches off when there is sufficient ambient light.
The 100µF capacitor (C1) provides a bit of hysteresis to prevent the circuit from jittering near the threshold level.

The 100u has no effect on the hysteresis or the threshold values. These are determined by the 555 and the 12v supply.
The 100u simply prevents the voltage on the top of the LDR rising or falling rapidly.
The 470k pot forms a voltage divider with the LDR and it changes the level of light needed to make the chip change states.

POWER SUPPLY

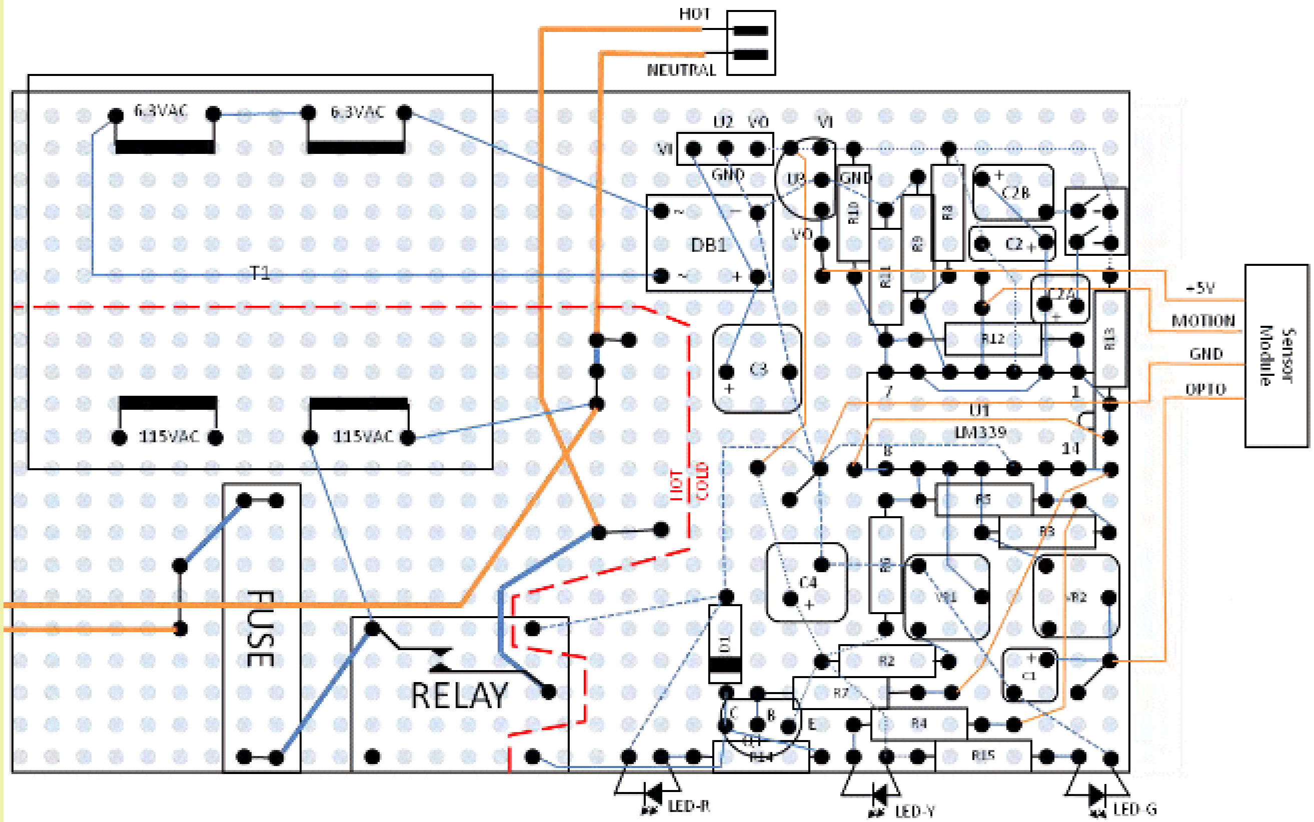
Here's another disaster from "professor" Mohan Kumar. And it will BLOW UP !!!!!!



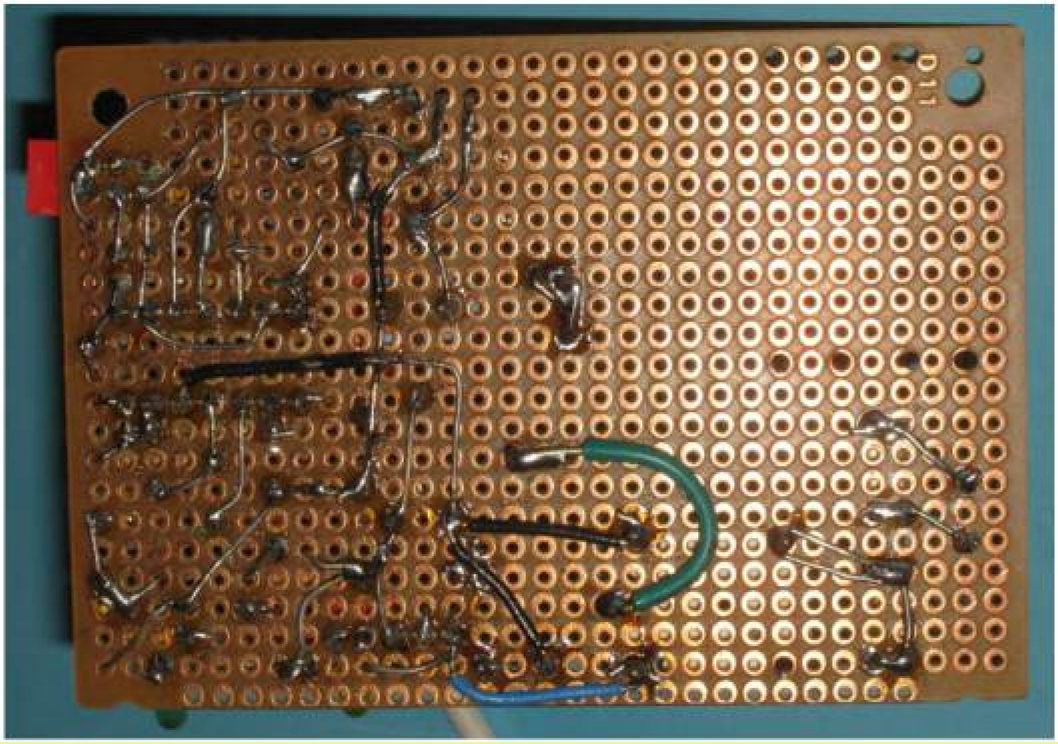
Mohan Kumar does not know how to calculate the voltage across the various components.
He does not know the basics of the power supply.
The whole design revolves around the current delivered by the two 1u capacitors. This is 150mA.
The circuit is a CONSTANT CURRENT design and the 150mA will pass through the 470R resistor, the zener and the 10R resistor.
The voltage across the 470R resistor will be .15 x 470 = 70 volts. The 25v electrolytic will BOW UP. You can see it has already blown up in Mohan Kumar's photo.
The wattage dissipated by the 470R will be V x I = 70 x 0.15 = 10.5 watts. You can see the resistor has already got very hot in the photo.
The dissipation of the zener diode is V x I = 12 x .15 = 1.8 watts. The zener in the photo is only 400mW.
Mohan Kumar has done no computations and just because he has tried it for a few minutes, does not make the circuit acceptable. It is an absolute disaster.
This power supply WILL KILL YOU. If it doesn't electrocute you, it will burn the house down.

SENSOR KIT

This is one of the reasons why kits have such a bad name:



The kit is built on MATRIX BOARD !!!!! The author hasn't even bothered to make a PCB for the kit.
And the kit sells for $45.00 !!!
And the instructions say to use the circuit diagram as the diagram above is not correct !!!
RELAY, SPDT, 12VDC, 360Ohm, 15A,120VAC
Relay can turn on/off AC appliances (300W max)
Why specify 15 amp relay for 2 amp load ?



The complexity of this project necessitates a PCB, especially as the mains is connected to the board.
Look at the poor layout and the power lead ALL OVER THE BOARD !!

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SPOT THE MISTAKES!

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TONE GENERATOR

Try this tinnitus checker to listen to a 32.7 Hz pure note.
http://www.szynalski.com/tone-generator/

You can download all the old electronics magazines from around the world when you go to
http://www.americanradiohistory.com/
They have over 5 million pages of amazing material.
You will be able to see how electronics developed over the past 80 years and even see Baird's mechanical TV.
It was the invention and development of the Cathode Ray Tube that surpassed the mechanical TV by 1,000% that led to TV as we know it.
Then there's the transistor (at a cost of one hour's wage per device) that miniaturised things to the point where they can fit a million transistors into a 50 cent device.
And there are thousands of other interesting things to see and download.
This site will keep you busy for hours.

The internet is growing at a phenomenal rate.
And it is the basis of our changing world.
The fact that anyone can have an equal presence on the web, has taken the power away from large corporations and delivered it to EVERYONE.
What has happened is this:
Large distributors of all type of products have now been challenged by small, enterprising, individuals who initially sold surplus or over-run stock or defect stock from markets and websites.
These individuals were brought together by eBay and Alibaba and through PayPal's

money-back guarantee, the rubbish was gradually eliminated and the quality was improved.

Not only were these "entrepreneurs" satisfied with a lower profit margin, but they "scooped the pool" by offering free shipment.

We now have the opportunity to buy just about everything one-at-a-time with no "handling charge" no "bank fee" and no postage charge.

Prices have plummeted and eBay has made purchasing so simple that two clicks of the mouse will buy almost anything.

The end result is the demise of the store-front, shop, warehouse and large distributor.

Even large super-markets have a shop-at-home service and when this becomes cheaper than doing your own shopping, you will see the super-market shrink in size.

Commercial rent is enormous and the only way to compete is to have a distribution centre with robot pickers making individual orders for customers and delivering them via a fleet of trucks.

The costly shopping-centre floor-space has been eliminated.

Where does this come in for you?

This is just one example of what will happen in the future and you have to see where other areas of change will occur and step-in with a solution.

You have to be ahead of the rest and use your skills in electrical, mechanical and electronics to create and solve a problem and even generate a whole new system to compete or take over whatever is presently in place.

It may be something as simple as a long hamburger in place of the round hamburger as it will be much easier to eat.

The simplest of ideas can take off in a matter of days.

When you have a cat video with 18 million views in 2 weeks, you have the potential of a world-wide market in less than a month for some new, brilliant, idea.

Hopefully you can incorporate some electronics into the product.

On 22nd June 2017 I donated all the Talking Electronics Computer prototypes to an Australian Computer Museum run by Alan Laughton

He says: I'm from the MSPP (www.microbee-mspp.org.au) where we are trying to preserve not only Microbee software & docs but also all other Australian Made & Designed vintage computers.
A number of our members have talked about the TEC-1 but we don't have info on it other than what's seen in the
early Talking Electronics magazines.

This computer was ahead of its time for the hobbyist and taught the basics of Z-80 processors.

You entered the program in Machine Language and it appeared on 7-segment displays or as sound via the speaker.

There were lots of other computers coming on the market that did much more and we could not keep up with progress.

But sales died to a point where we no longer added new projects and now all the remaining components have been donated.
It's good that everything from the past has been kept by dedicated people as there is always one in ten thousand people who want to know how things developed. It doesn't matter if it is the magnetic mine or the Enigma machine or even the step-by-step relay for the telephone, looking at one persons inventive qualities can inspire you to do more yourself.
How do you think I became so competent? I looked at other's achievements.
I became a teacher, printer, TV serviceman, writer, electronics designer, builder, electrician, plumber, share trader and dog walker.
Look at the latest spaceman. 180 days in orbit. Never finished school.
Don't let education get in the way of your goals and don't let your goals get in the way of education.
It's wonderful to have both. But passion, perseverance and determination is the only thing you need.
In one word it is called GRIT.
It's the art of seeing something and sticking to it.

A READER'S EMAIL:

I get a number of emails each day from grateful readers and I include them on the website because everyone wants to know what other's are experiencing and how they have benefited.
Don't forget, I only get a reply from about one in 10,000 visitors and the same with orders.
The response from magazine orders, some 30 years ago, was greater than 600 per month from a sales of 12,000 magazines.
But hobby electronics is now a much smaller field and fewer beginners are taking an interest.
I can understand this as the potential for employment in this area is considerably less than previously.
However it's a bit like a singing or music career. Not everything is done with the intention of a monetary reward, and if you have a "bent" for mechanical, electrical, chemical, musical or geological investigation, you should take it up, continue and be fully absorbed as the only way to keep yourself alert is to meet challenges all the time.

Here's an email from Shane:

Hey Colin,,

I hope you are well!
I often think fondly of you when I come across problems similar to what I‘ve found on your site and wonder how I would handle them without the guides I spent weeks and weeks reading and learning from on your website.

It’s a great reference site for me and I still use it often to look at circuits and get ideas on how things should be done.
I’m still learning new things each day and the more I learn, the more I realise I’ll never have the time to cover it all.
I still have all your books and I’m still not a millionaire. Maybe one day.

Best Regards!
Shane
Sales Engineer

---

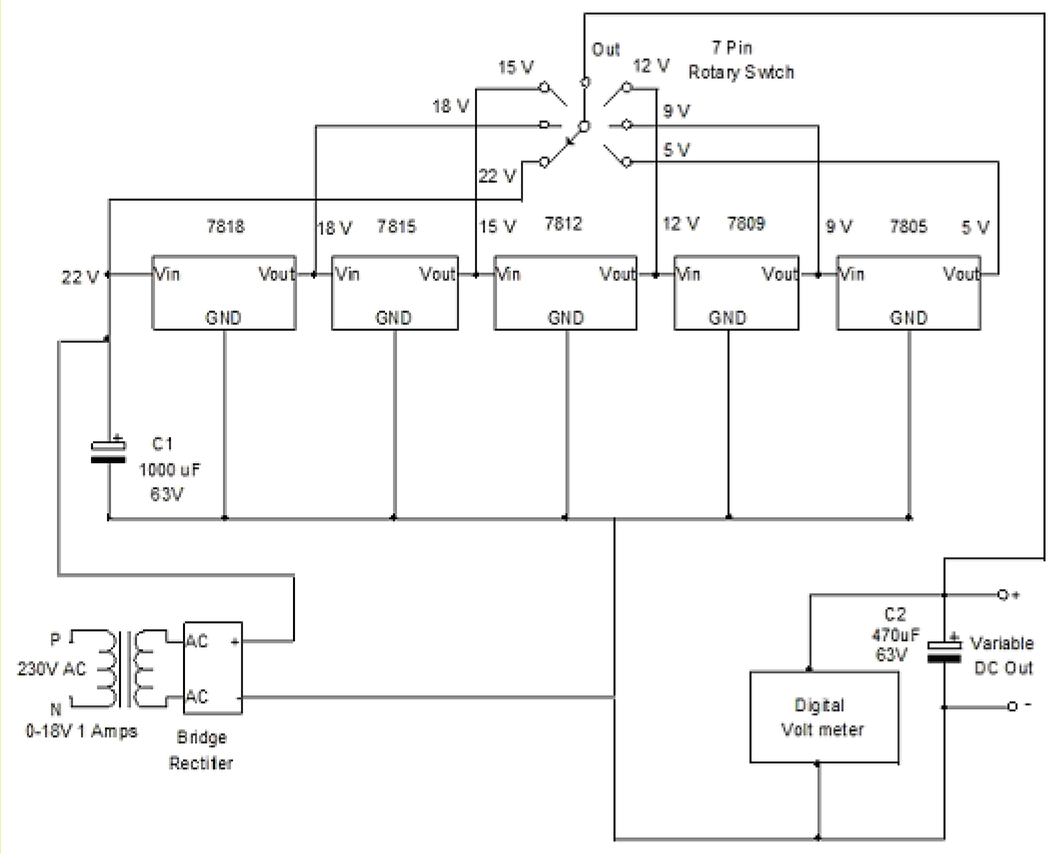
and another email from a reader of this section of the website:

Dear Sir,
Your Spot the Mistakes pages are the most wonderful items I ever came across on the Internet. I read them daily and hold unto them like a rare talisman. The mistakes pointed out were so glaring and unnerving that it becomes obvious most professors need to discard armchair design and/or analysis of electronics. It shows an incurably defective reasoning, daft mentality and myopic viewpoint on accepting correction. How do they teach others if they are unwilling to learn?
But if you observe Nigerian professors you may develop regularly recurring heartache due to complete non-availability of basic teaching methods, not to talk of actual knowledge. The most tragic part of it is most of the textbooks we use here are written by Indians with no reviews by any electronic or even electric engineer in the whole country. I know it! Not all Indian engineers are incompetent but the dimension is severely worrying. This is just the tip of our iceberg.
Keep on the good work and the Spot the Mistakes section.

Sadiq Shehu Dokaji
Kano University of Science and Technology
Kano State, Nigeria

I get lots of requests for areas of electronics that I do not cover.
Firstly, I don't know everything about electronics and secondly I don't talk about anything that I have not actually experienced myself.
No matter what you want, it is covered on the web.
It is the greatest learning tool since the text-book and it it faster, cheaper and more expansive than any book or course.
It is something you have to investigate before thinking a $3,000 course will provide you with the answers. Just because the web is FREE, does not mean it not informative.
The best things in life are FREE. And the internet certainly holds this to be true.
But you cannot live by bread alone. You MUST build, build, build.
My wall is filled with boxes of prototypes.
No kit is released without firstly building a prototype and then putting a kit together.
A kit must be able to be put together without any external assistance. The legend on the top of the board must identify everything for it to be successful.
You will see many projects in this section (from other people) with blank PC boards or parts crammed in a corner or leads all over the board.
This sort of design is quite unsatisfactory.
These boards need a re-design and may be done with a double-sided board. But none of your half-finished work should appear in a magazine. The quality of the board shows the capability of the designer. And some designers have NO capability.

Every time you go to the super-market, do you end up in the slow check-out???
It happens EVERY time.
This time it has happened with the PIC chip and Arduino.
Arduino projects use the AVR family of chips from Atmel and PIC released their first chips in 1976 while the AVR chips were first released in 1996 so the developers had 20 years to look at what had been developed in the microcontroller field.
I am not saying the concept was copied but the similarities of the two designs are almost identical.
MERE CO-INCIDENCE !!!
However the annoying part is the take-up of the Atmel chips by a group of individuals who shared their ideas and projects and programs as an open-source venture.
This had enormous impact on the development of projects for this range of microcontrollers and very soon the focus was taken away from PIC and concentrated on the ATmega range of micros.
I can understand the pointlessness of having two streams of designs to cater for each range of chips but it would be a simple matter to produce a conversion program to allow a program to be sent to either range. This would have prevented PIC chips from falling by the way-side and becoming almost no-existent in any of the hobbyist robotics areas.
Microchip (PIC) has done nothing to enthuse the hobbyist and encourage the use of PIC chips and even the programmer is inordinately expensive.
There is nothing from Microchip to get you started.
They don't even produce a socket so the 8 or 16 pins chips can be programmed.
Neither do they have the instruction-set printed in easy-to-understand format or a library of routines to help you produce a program.
Everything comes in the form of APPLICATION NOTES and you have to be a professional programmer to understand what they are saying.
That's why do you do not see any simple projects using a PIC chip.
Even a simple project comes from someone who really understands programming.
My idea is to produce a programming book with a free PIC programmer on the cover.
Clones are already available on the web for $12.00 posted and mass-production would reduce this to $6.00 for Microchip.
I wonder if Microchip will ever wake up to the enormous potential they missed out on.



You only need one regulator IC and some zener diodes

Here is another "mess-up" from Professor Mohan Kumar, from India:

Two 1 ohm resistors in series!!
The resistance should be 4.6 to 5.6 ohms - NOT 2 ohms !!!

It is a 1-watt LED to be connected to the USB of a computer:

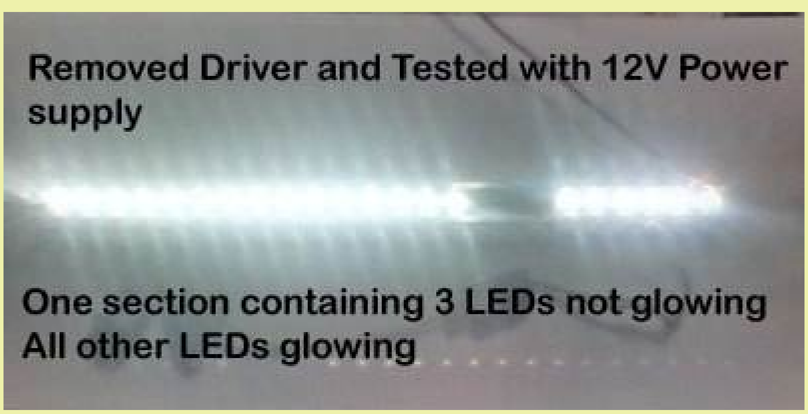
A 1-watt LED has a characteristic voltage that will develop across it of between 3.3v and 3.6v. This voltage will be in the range of 3.3v to 3.6v, no matter what current is flowing. The actual voltage will depend on the characteristic of the crystal and will not alter.
To find out the actual voltage for the LED you are using, connect a 10 ohm resistor in series and connect to the USB port.
This will allow less than 100 mA to flow and you can quickly read the voltage across the LED.
The current through the LED MUST NOT be more than 300mA because we are not heatsinking the LED and it will get very hot.
If you connect two 1-ohm resistors to the LED, the current will be 5v - 3.3v = 1.7v / 2 = 850mA !!!
If the characteristic voltage is 3.6v, the current will be 1.4 / 2 = 700mA !!!

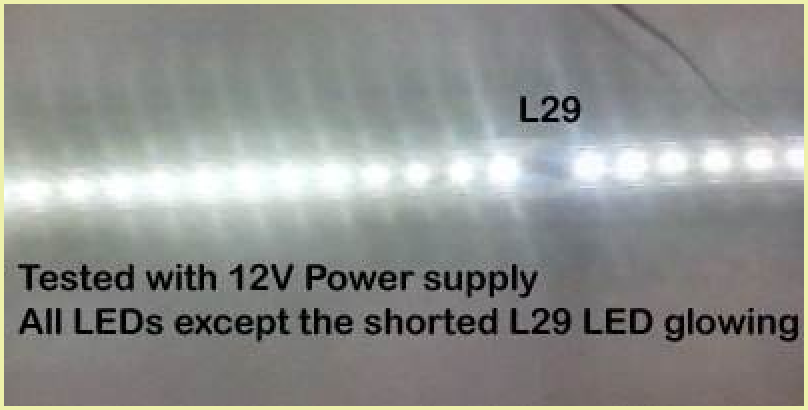
The correct resistor-value is:
5v - 3.3v = 1.7v / 0.3 = 5.6 ohm
If the characteristic voltage is 3.6v, the resistance will be 5v - 3.6v = 1.4v / 0.3 = 4.6 ohm

The value of resistance is very critical. You will also find the resistors get hot as about 400mW will be dissipated.

LED TUBE

More bad advice from Professor Mohan Kumar:

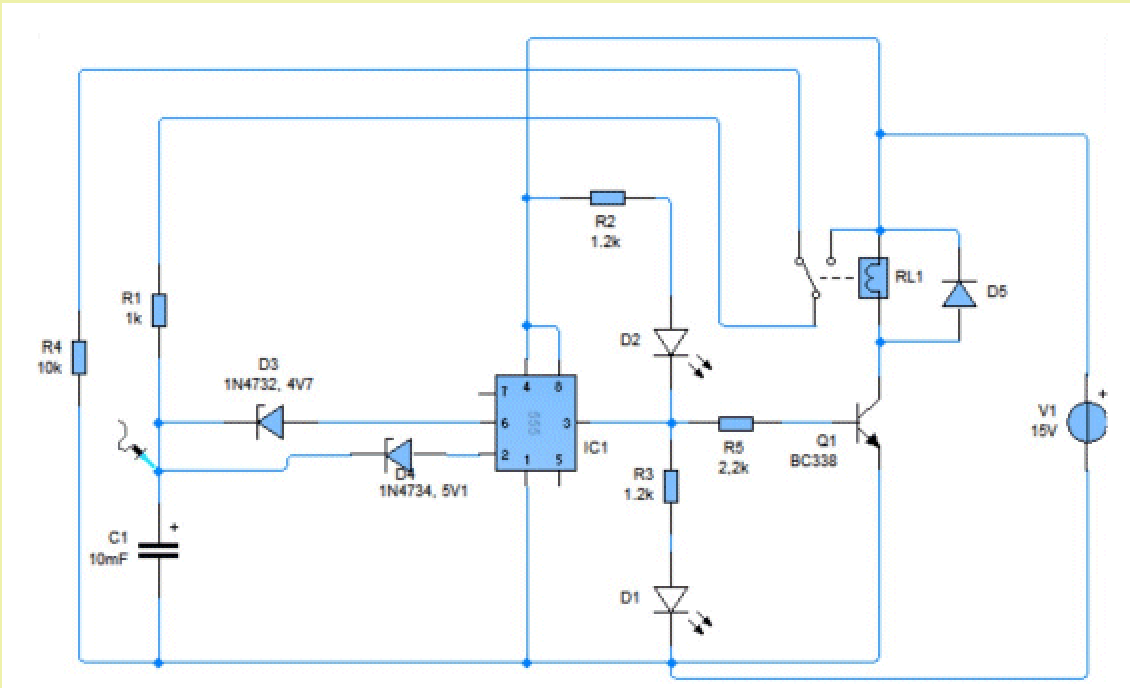




This is NOT how to repair a LED TUBE or any LED device contain a number of LEDs in series.
Most of these LED items drive the LEDs at maximum brightness and thus they deliver the maximum current through each of the LEDs.
This current is controlled (limited) by a "dropper resistor" and the value of the resistor has been worked out by knowing the voltage of the supply and the natural characteristic voltage drop across each of the LEDs in the string.
The current should be 17mA for very long life, 20mA for good brightness and 25mA maximum to get the maximum brightness.
If the supply is 12v, the characteristic voltage drop across each LED will be 3.2v to 3.6v and using 3.4v as the average, the total LED voltage will be 3.4v x 3 = 10.2v.
This will leave 1.8v for the voltage across the dropper resistor.
If 25mA flows, the resistance of the dropper resistor will be 72 ohms.
If we remove one of the LEDs, the characteristic voltage-drop across two LEDs will be 6.8v.
This means 12v - 6.8v = 5.2v will now appear across the 72 ohm resistor.

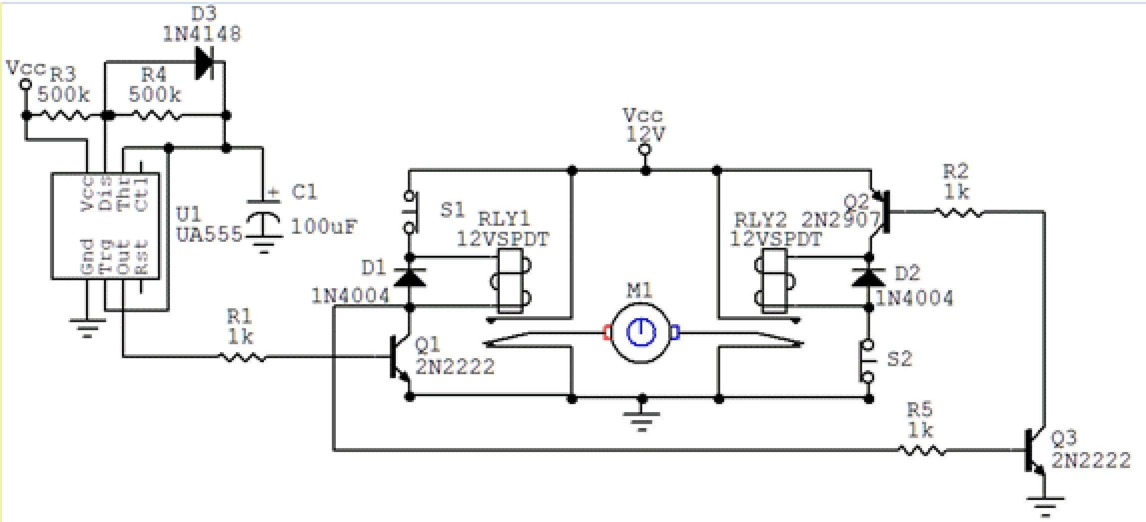
The current flowing through the resistor will be 72mA.
The two LEDs will not appear to be any brighter because they were originally producing maximum brightness, but the current is now far greater than the LEDs will tolerate and they will very quickly BURN OUT.
This is simply another ignorant design by Professor Mohan Kumar, who consistently delivers bad information on the web.
That's why you have to be careful when searching the net, to avoid disastrous comments like this.

555



I just want to concentrate on the two zener diodes.
Input pins 2 and 6 are very high resistance inputs.
This means it is exactly the same as connecting a zener to "nothing."
In other words the cathode goes to the 10mF and the anode is "floating."
The zener diode consists of a crystalline structure and it has a very high resistance.
Because the anode is not connected to anything, it will rise to exactly the same voltage as the cathode.
This is how you look at the circuit.
Now you can see why it will not work.

MOTOR REVERSER



Here's an interesting circuit from an electronics forum.
No-one on the forum found the mistake.
The motor never reverses. What is the problem?
HINT: The first relay "pulls-in" but does not release.

When the first transistor is turned OFF, the second transistor turns ON and the second relay is energised.
The base current for the second transistor passes through the first relay and the 1k resistor on the base will allow about 10mA to flow through the relay.
This will keep the "clapper" energised and it will "stick" to the pole of the relay and prevent the motor reversing.
The solution is to increase the 1k to 47k and the current through the relay will be so small that it will "de-energise."

MOBILE PHONE EMERGENCY CHARGER

All mobile phone emergency chargers are really a waste of time.
But in this article we will explain how to relate the capacity of the emergency battery to the phone battery.
There are two types of emergency chargers.
The complex type uses a switch-mode circuit to convert the energy in the emergency battery to charge the mobile phone.
If the emergency battery is 1.5v alkaline cell and has a capacity of 2,400mAhr, and the phone battery is 3.7v @ 1,800mHr, the battery 1.5 x 2,400 mWHr = 3,600mWHr will half-charge the phone battery (6,600mWHr).

If the battery is 9v and a simple regulator is used to charge the phone battery, you will only pass half the energy of the 9v battery because when the battery voltage drops below about 5v, no charging current will flow.
A 9v carbon-zinc battery is rated at about 200mAHr when delivering 15mA and has a lower capacitor at say 100mA.
However if we used this type of battery only about 100mAHr to 150mAHr of energy will pass into the phone battery. This is only about 5% to 8% charge and is hardly worth-while. A 9v battery costs about $1.00 and it is an expensive way to charge a phone.

7x5 DISPLAY

When will **Electronics For You** get a technical editor ??
Here is a circuit from August 2016 magazine:

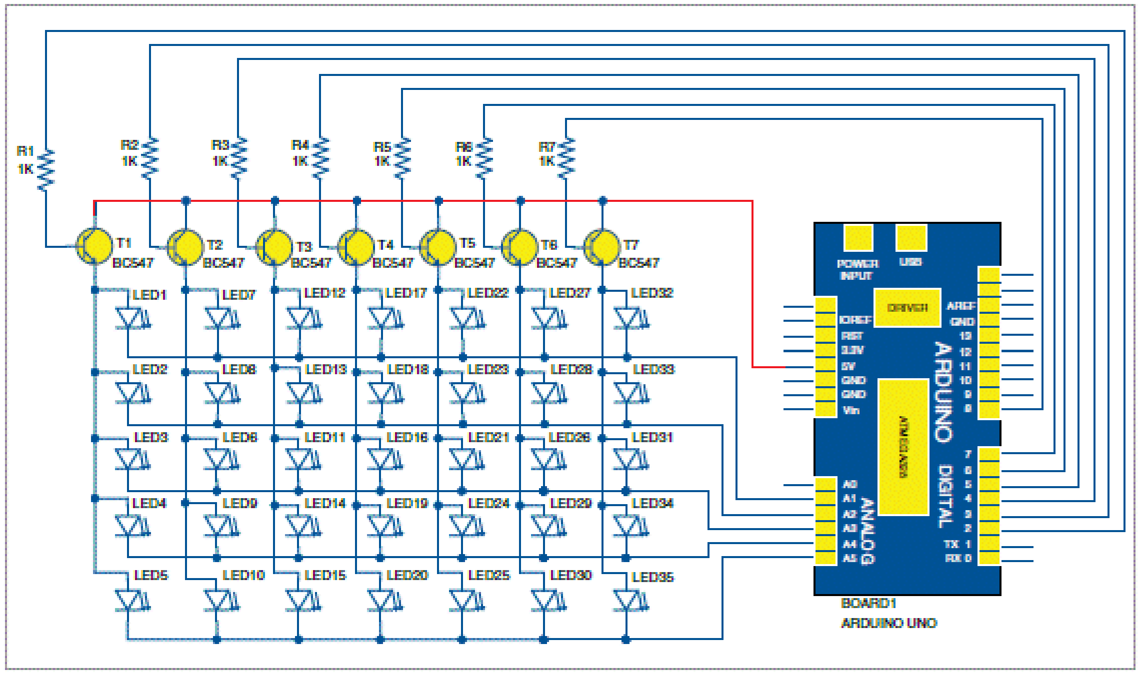
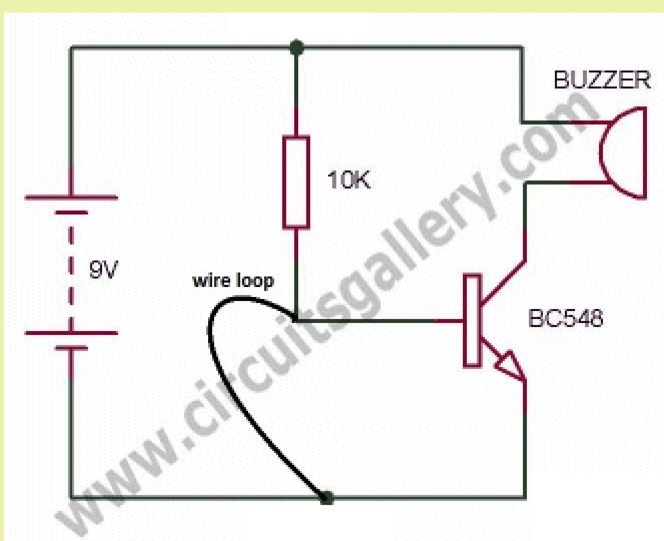


Fig. 1: Circuit diagram of the 7x5 LED matrix using Arduino

There is no current limiting resistor on any of the LEDs.
This is a very important component and MUST be included.
The output FETs on the microcontroller are very small and are designed to deliver about 20mA maximum.
When they are turned ON, the voltage across them is less than 0.5v and thus 10mW is being dissipated.
When a resistor is NOT included, the FET can only "pull down" by an amount equal to the characteristic voltage of the LED in the display.
For a red LED, this voltage is 1.7v and for a white LED it is 3.4v.
The voltage across the collector-emitter terminals of the transistor will be less than 0.5v and this means the voltage across the FET will be between 2.3v and 0.6v
BUT because the FET is sinking in this type of circuit, the current will not be limited to 20mA but will increase to about 40mA because the LED is acting like a zener diode and it is just like putting a 2.3v supply-rail on the pin of the micro and asking the micro to pull the 2.3v lower.
The dissipation of the FET is now 80mW and this is 8 times greater than before.
It is lucky the micro is very tolerant, but if you were to do this in a high-current situation, the result would be premature failure.

LOOP ALARM

Here's another bad design from Professor Mohan Kumar:



The circuit above takes nearly 1mA when sitting around.
If you use a 9v battery, it will last about 200 hours. That's about 10 days !!

This type of fault was one of the reasons for the introduction of this series; SPOT THE MISTAKE. On page 2 you will find a KEY HOLE LIGHT that took only a fraction of a milliamp when sitting around but the battery went dead in 3 months and the project was a failure.

Here's the circuit:

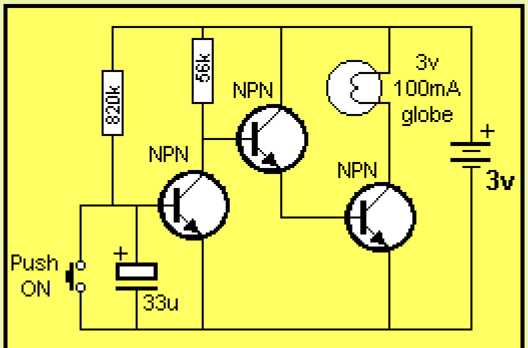


Fig: 10. The Key-hole light circuit

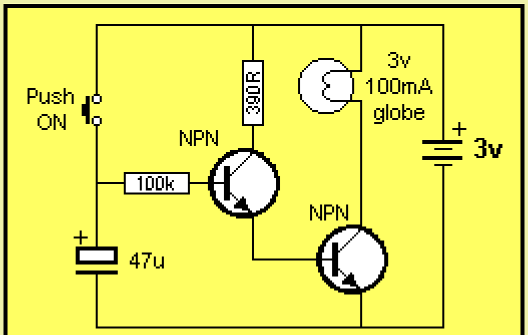
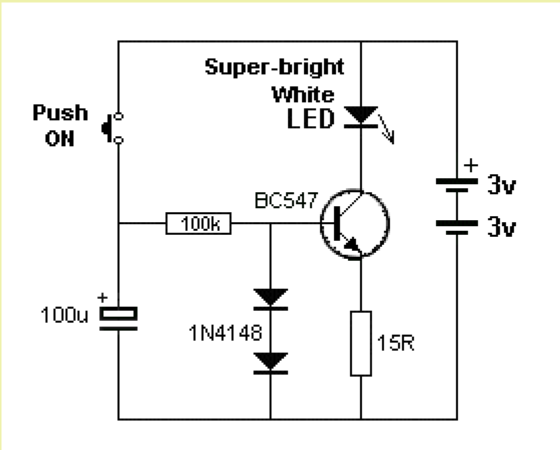
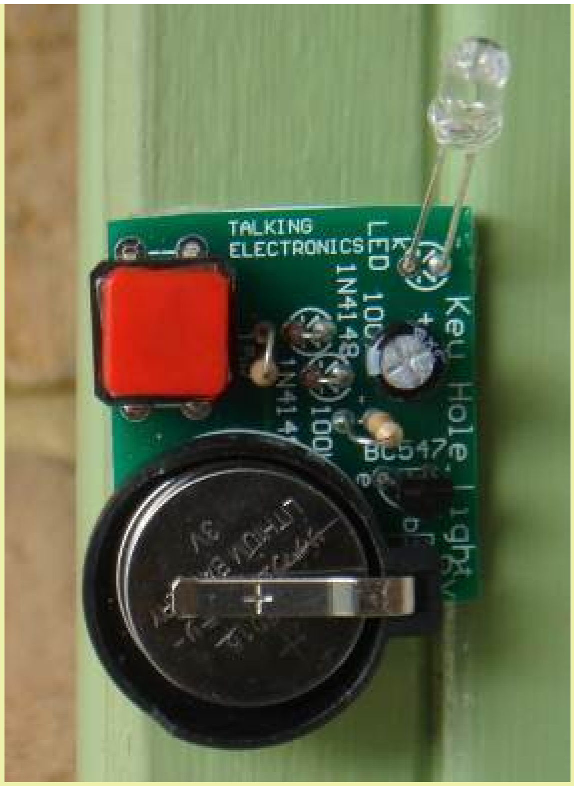


Fig: 11. The improved key-hole light circuit

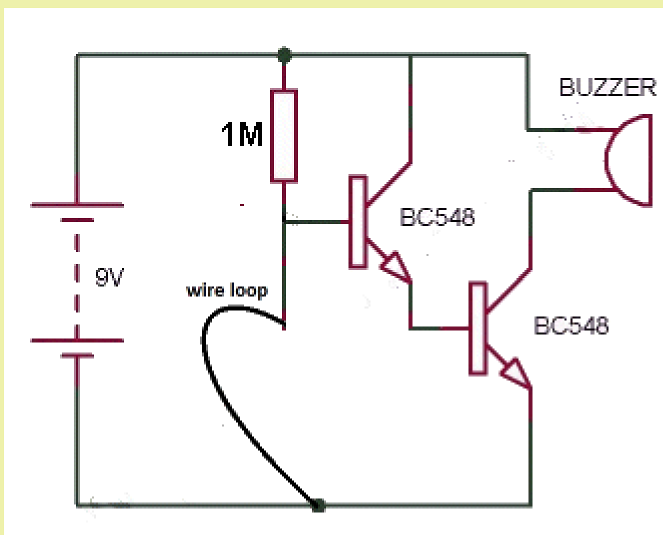
The solution was a simpler circuit that took no current when sitting around.

This circuit has now been turned into a project: KEY HOLE LIGHT
Here is the circuit:





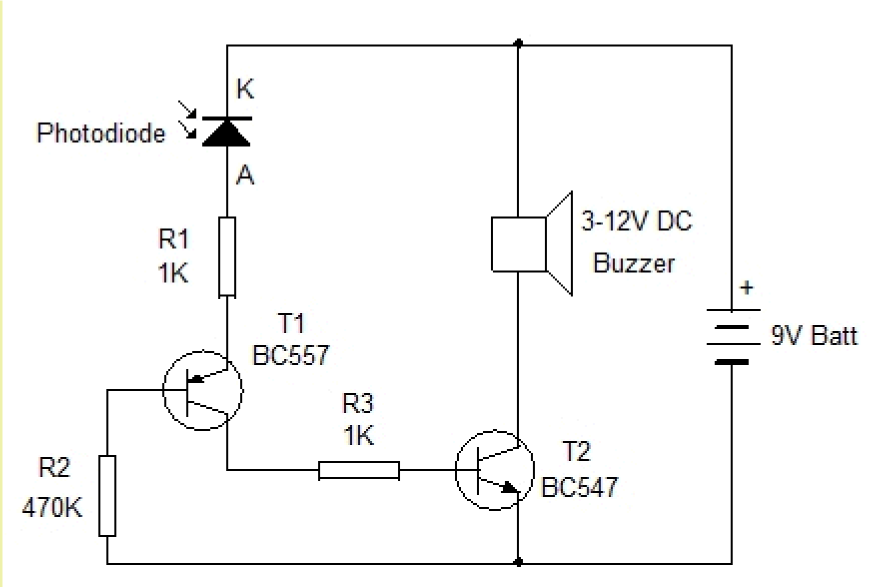
Key Hole Light kit can be bought from Talking Electronics



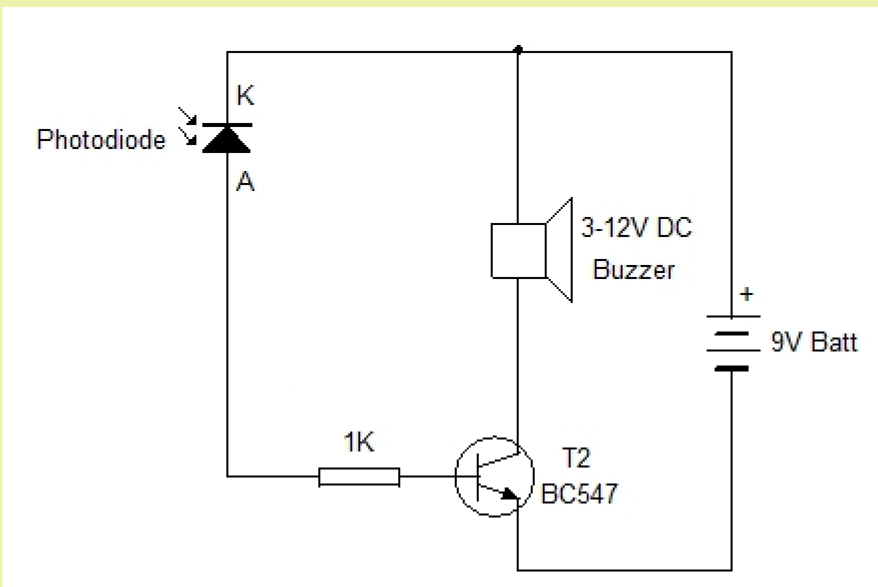
The current in the wire loop cannot be reduced to zero, but by adding an extra transistor, the current can be reduced and the battery will last 100 times longer.

IR ALARM

Here's another bad design from Professor Mohan Kumar:

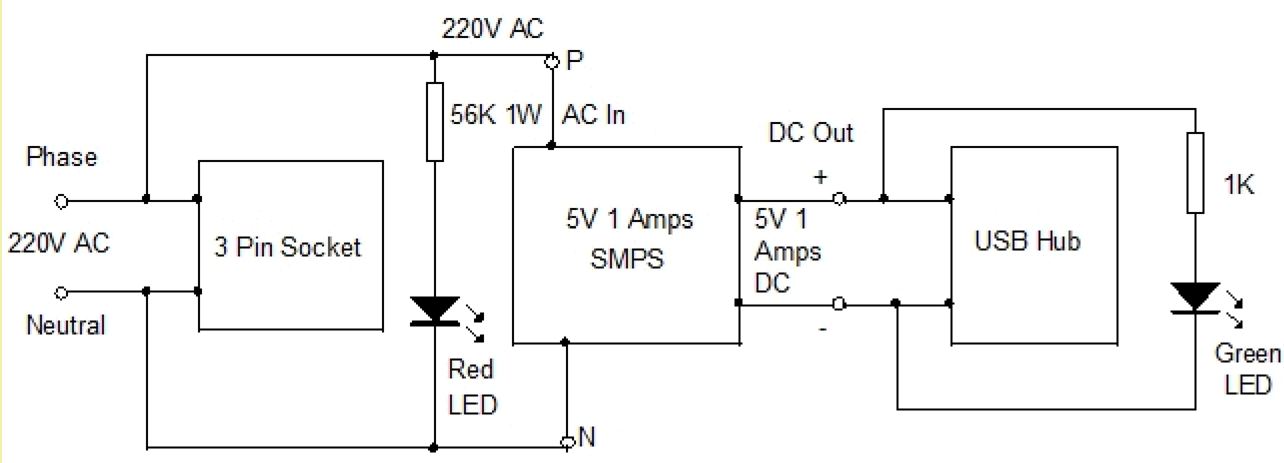


The first transistor is not providing any amplification. It is simply turned ON by the 470k and the emitter current is the same as the collector current. When the photodiode detects more heat from a flame, it passes more current and this turns on the Buzzer.
But the first transistor can be removed and the circuit will work exactly as before. It is not needed:



This is an example of not checking each component to see if it is needed.

LED will BLOW UP !!!!



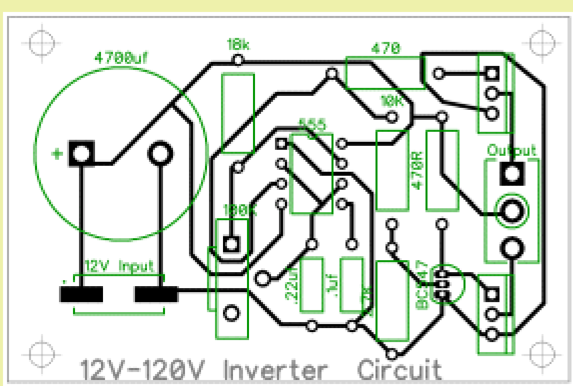
A LED will be damaged if it sees a reverse voltage above about 5v. In the circuit above the red LED sees more than 310v in the reverse direction and a current of about 5mA.
Another bad design from Professor Mohan Kumar.
He does not test ANYTHING !!!!!

3.6V 2.4A Lithium Thionyl Chloride Battery

ER14505
* Lithium Thionyl Chloride Battery
* Size: AA
* Volts: 3.6V
* Current: 2400mA

This advertisement has one major mistake. The CAPACITY of the battery is 2400mAhr.
The recommended discharge current is 100mA.
It is NON-RECHARGEABLE.
Always check specifications of a product before buying ANYTHING. Check out the details on other websites.

A reader asked me to check his PCB.

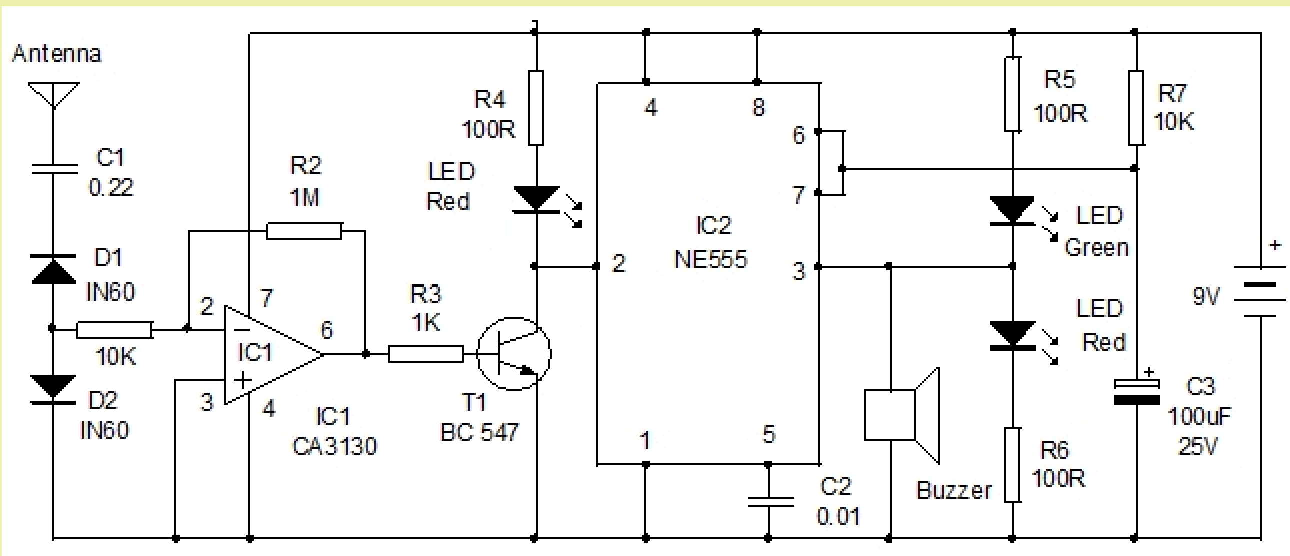


It is not my job to check your layouts. I have lots of other things to do.
He said the positive track had brunt out.
All the tracks (called traces) are far too thin (narrow) for a high-current project. The tracks to the output transistors and the power supply will be taking between 1 and 5 amps.
Normal Printed Circuit Board has 1 ounce of copper per square foot and this corresponds to 1.4 thousands of an inch thickness.
80gsm paper is 4 thousands of an inch thick, so you can see how thin the tracks are.
The thinnest (called narrow) tracks on a normal PC board are 10 thousands of an inch (called 10 mils) and this will carry 1 amp. (I would never take the risk. Use 20 thou or 25 thou).

Temp Rise	10°C	20°C	30°C
Width (mils)	Max Current (A)		
10 thou	1	1.2	1.5
15 " "	1.2	1.3	1.6
20 " "	1.3	1.7	2.4
25 " "	1.7	2.2	2.8
30 " "	1.9	2.5	3.2
50 " "	2.6	3.6	4.4
75 " "	3.5	4.5	6
100 " "	4.2	6	7.5

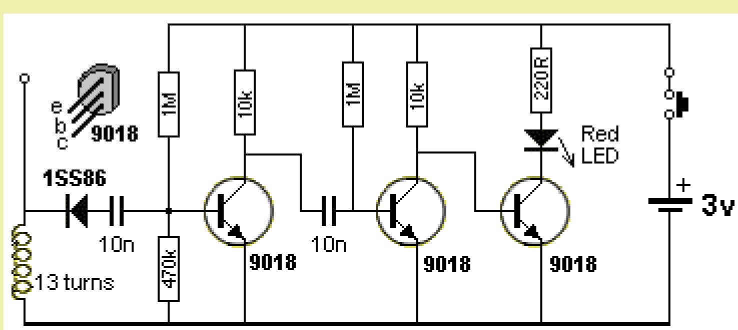
The tracks needs to be 100 thou to carry a current of 4 amps.
The tracks on the board above are 25 thou (wide) and need to be 4 times thicker (WIDER) to carry the current.
You can either use printed circuit board having 2oz copper, increase the track width or solder 0.5mm tinned copper wire along the high-current tracks.

DETECTING A MOBILE PHONE



This is another bad design from Professor Mohan Kumar. The circuit detects a mobile phone.
I do not know if it is successful or not.
1. Mobile phones operate at 2-3GHz and a 1N60 diode will not function at this frequency.
2. What is the purpose of the 0.22 on the antenna????
He says: "***To capture the RF energy from the Mobile phone, a Diode – Capacitor combination is used along with the Antenna. Diodes 1N60 capture the RF energy from the active phone and capacitor C1 stores this energy***."
How can a capacitor store energy and deliver it to the circuit when only one lead is connected to the circuit ???

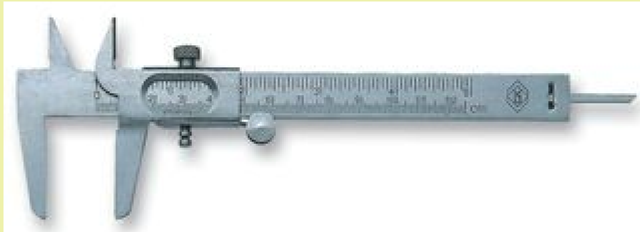
Here is a circuit using a very high-speed diode. This circuit works:



More details on this circuit can be found [HERE](#).

WHAT A JOKE!!

A major electronics supplier is selling a venier caliper: (What is a venier caliper ???)

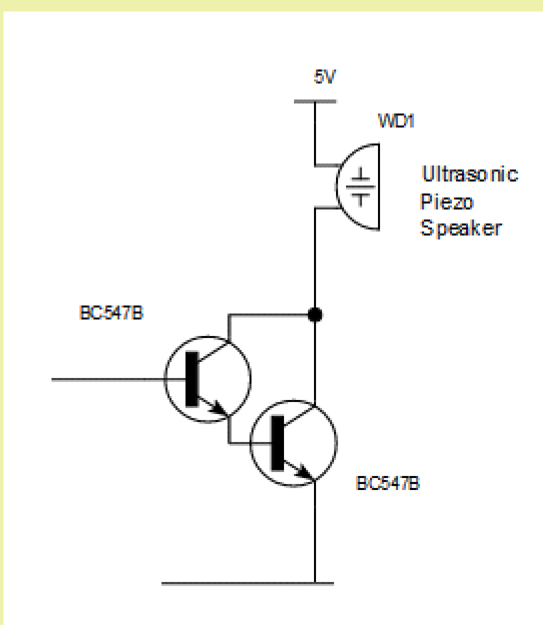


Cost: $12.00 (delivery $15.00)

From Alibaba, you can get a DIGITAL CALIPER:

Cost: $8.00 with free delivery

PIEZO DRIVER



You are lucky this circuits works at all.
The piezo speaker is actually a 22n capacitor. When the transistors turn ON, the capacitor charges. When the transistors turn off, what discharges the capacitor ??? Nothing.
When the transistors turn on again, the capacitor is already charged. That's why the output from the piezo will be very small.
It would be better to drive the piezo directly from the output of the microcontroller. At least the output will be push-pull and this will charge and discharge the 22n capacitor to produce a loud output.
Why use 2 transistors ?
You lose about 1v across the Darlington pair.
Just a bad design from a person who has not studied electronics.

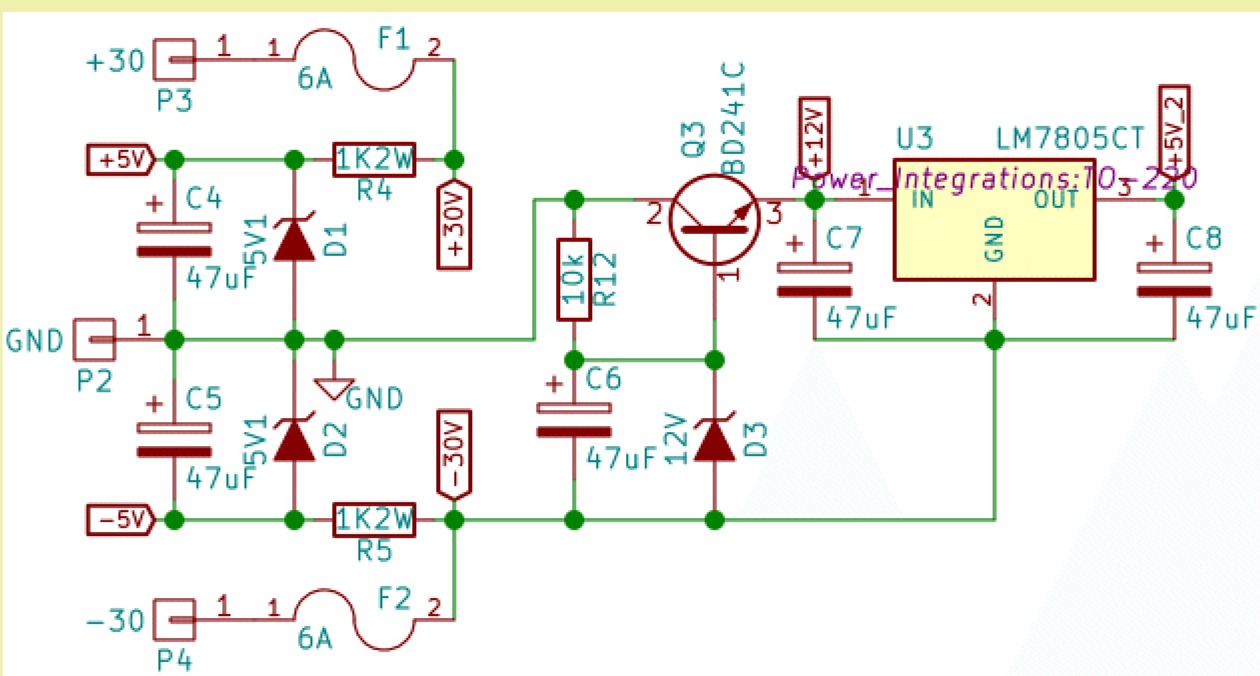
NO KITS

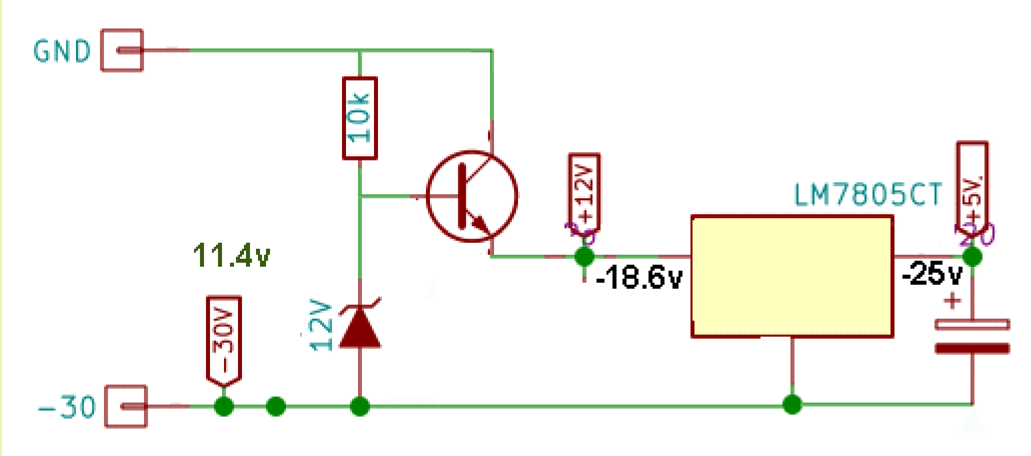
I downloaded Sept 2016 issue of **ELECTRONICS FOR YOU** and linked to 3 suppliers of kits.
The 3 websites had no images of any kits. No kit details and no prices. Why spend money on a magazine advertisement and not back-up the "fancy ad" with availability of kits. Where are the Robot kits? Where are the 400 Educational kits?
The magazine is full of HYPE. They simply regurgitate electronic developments from around the world and fill the pages with "wishful thinking."
Instead of presenting MADE IN INDIA, they say: MAKE IN INDIA.
Who would bother to make anything in India when there is no infrastructure.
None of the projects are available from the magazine and none of them have been photographed with the PC board. Only matrix-board prototypes are shown.
No-where in the magazine does anyone offer a PC board or request a PC board. It's all just a dream.

+12v

The following circuit is classified as a DUAL RAIL SUPPLY.
The main points to note are:

The position of the GND. This is the 0v rail and is the rail where all voltages are measured.
Note the minus 30 rail. This the only rail we are interested in.



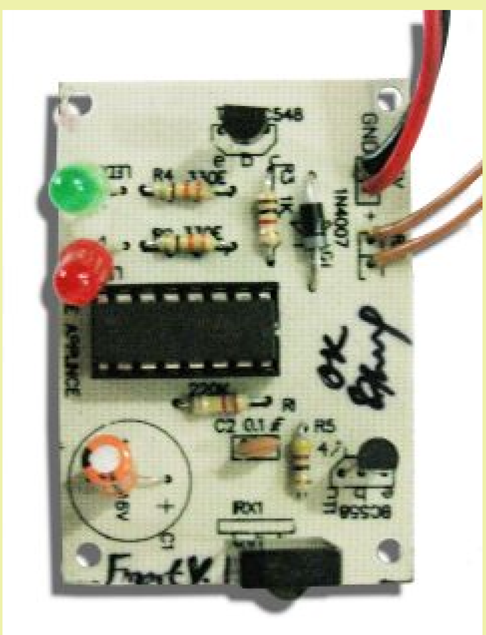


All voltages must be referenced from the 0v rail (called CHASSIS or earth) as this is where you will place the black probe of the voltmeter.
The voltages on the 7805 will be minus 18.6v and minus 25v.
Neither of the voltages will be stable as the minus 30v rail (line) is not stable.
The 7805 voltage regulator will have no effect on stabilising the voltage.

KITS N SPARES

This is the sort of rubbish from the kit section of **ELECTRONICS FOR YOU:**

kitsNspares.com
For the 'engineer' in you



Kit cost: $5.00 USD
Postage costs: $334.00 !!!!

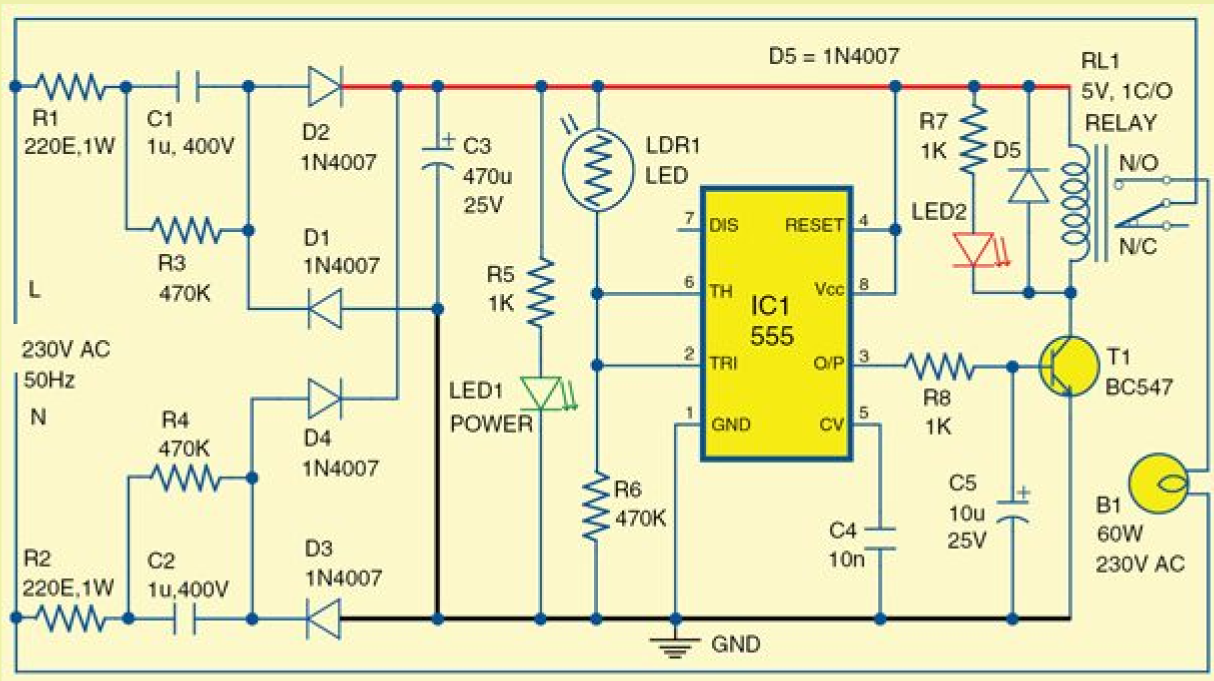
Look at this mess!!!

Look at the the PC board !!!!!!
Look at the electrolytic !!!
No IC markings. No IR receiver markings.
All my staff produce better boards than this. These boards are absolutely ghastly.

How can a magazine allow rubbish like this to be sold to experimenters ?????

Electronics For You is giving away their magazine each month. If you subscribe for 12 issues, they give you a discount. Then they send you a multimeter and finally you have to only pay $1.75 for 12 issues.
The postage alone would cost them more than $2.00 !!!!
It reminds me of POPTRONICS with a $19.00 subscription. They paid the subscription-house $6.00 and got $1.00 per issue. The postage would have been more than $1.00 per issue. Finally they went bankrupt.

240v LAMP



Apart from the fact that all capacitor-fed power supplies are very dangerous, this power supply will not work because the Neutral is effectively connected to the earth lead inside the "power point" and they both rise and fall at the rate of 50 times a second.
Look at the circuit diagram.
The Neutral and the earth are both connected to the circuit.
This means there is a "piece of wire" connected between "N" and the "GND" on the circuit.
This means the lower 220R resistor, 1u 470k and D3 can all be removed and replaced with a piece of wire, because none of the leads rise higher than 0v.
Now we have D4 not doing anything so it can be removed.
Now we have the "L" wire (the live or LINE) rising to 340v and then falling to minus 340v while the "N" wire remains at 0v AT ALL TIMES.
When the "L" wire is rising, it is delivering an average of 70mA and when it is falling, the capacitor is being discharged through D1. This means it is delivering 70mA for half a cycle and zero mA for half a cycle. This gives an average of 35mA.
There is no zener diode in the circuit to control the voltage produced by the capacitor, however the components produce a load and this will reduce the voltage to some unknown value.
The first LED will take about 5 to 10mA and the 555 will take 10mA. This leaves 20mA. When the output turns ON, the second LED will take 5 to 10mA.
Where is the current for the relay ???
Just another junk circuit from Mohan Kumar.

Here's more rubbish from TK Hareendran:

It is an untried, untested, un-workable, idiotic design.

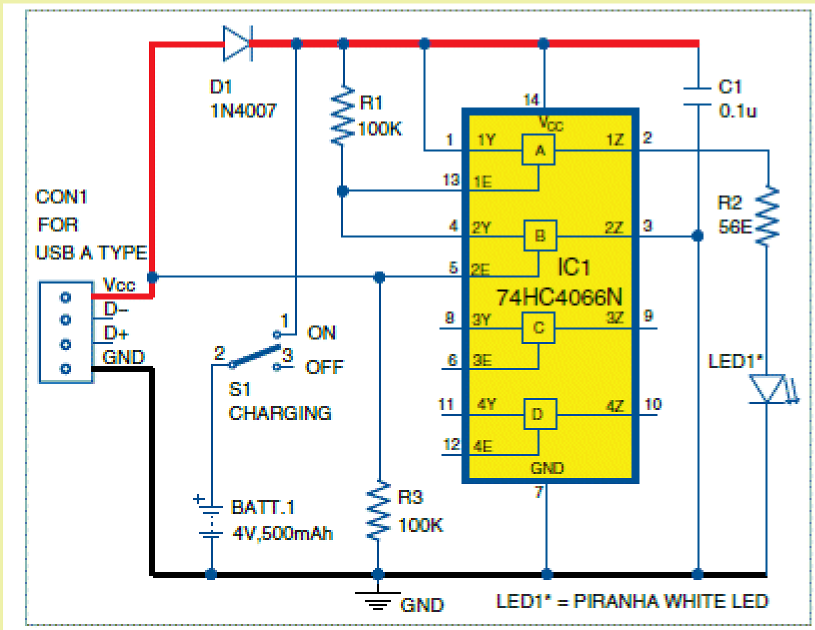
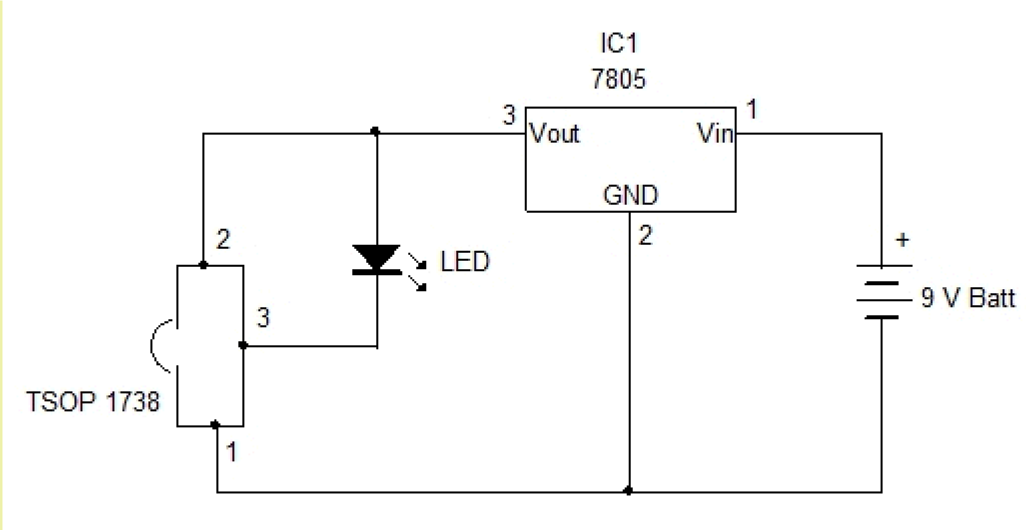


Fig. 3: Circuit diagram of the USB LED night light

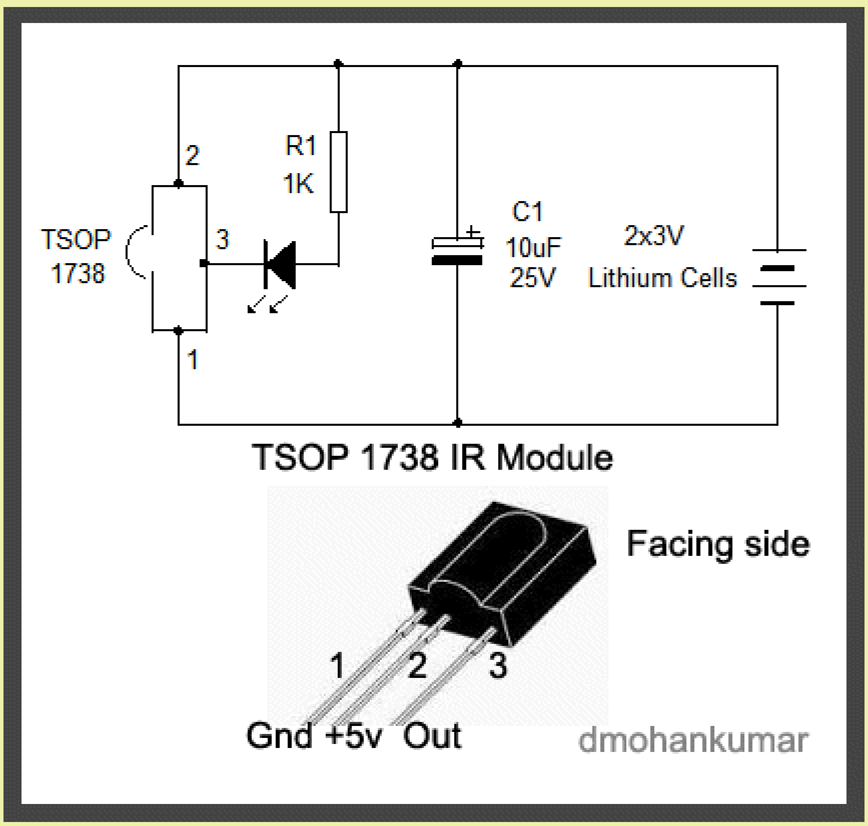
For a start, a sealed lead-acid battery with 2 cells has a terminal voltage of 4.2v and needs to be charged at a minimum of 4.6v. The 1N4007 has a characteristic voltage drop across it of 0.7v. This adds up to 5.3v.
USB ports deliver EXACTLY 5v. How is this going to charge the battery ??????

A Piranha white LED requires up to 180mA.
The 4066 IC will deliver 10mA from each output at 5v. How is this going to illuminate a LED?
Why not use a simple transistor circuit ???
How can **ELECTRONICS FOR YOU** (October 2016) publish such a JUNK CIRCUIT ?
Simply because they have no technical engineers.
All the gloss and hype in the magazine means absolutely NOTHING.
It is all commandeered from other sources and cobbled together to make it look like India has an electronics industry.
It's all: "copy this" and "steal that."
Instead of MADE IN INDIA, they promote: MAKE IN INDIA.
India wants $120.00 USD for a PCB panel I get made in China for $25.00. (postd)
India has copied a number of IC's and transistors, but NON-ONE SELLS THEM !!!!
India has no infrastructure.
There are 6 advertisements for kits in **Electronics For You** October 2016, but when you go to the websites, nothing is available.
Two of the biggest kit manufacturers have disappeared !!!
Another 4 suppliers do not send kits overseas and 3 more want $25.00 to post a $5.00 kit !!!
China hast post-free options.
China has Alibaba.
China has infrastructure.
China actually DELIVERS.
India is living in a dream-world. I have tried for 2 years to get a reply from India. NOTHING !!!!
Not one thing has been sent to me from India.

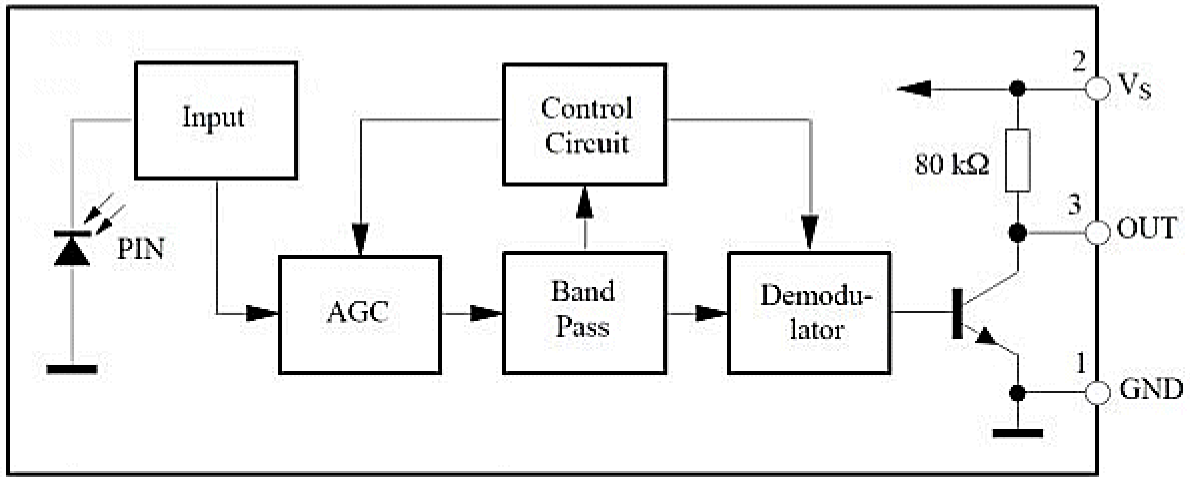
Here's another disaster:



There is no current limiting resistor on the LED in the circuit above.

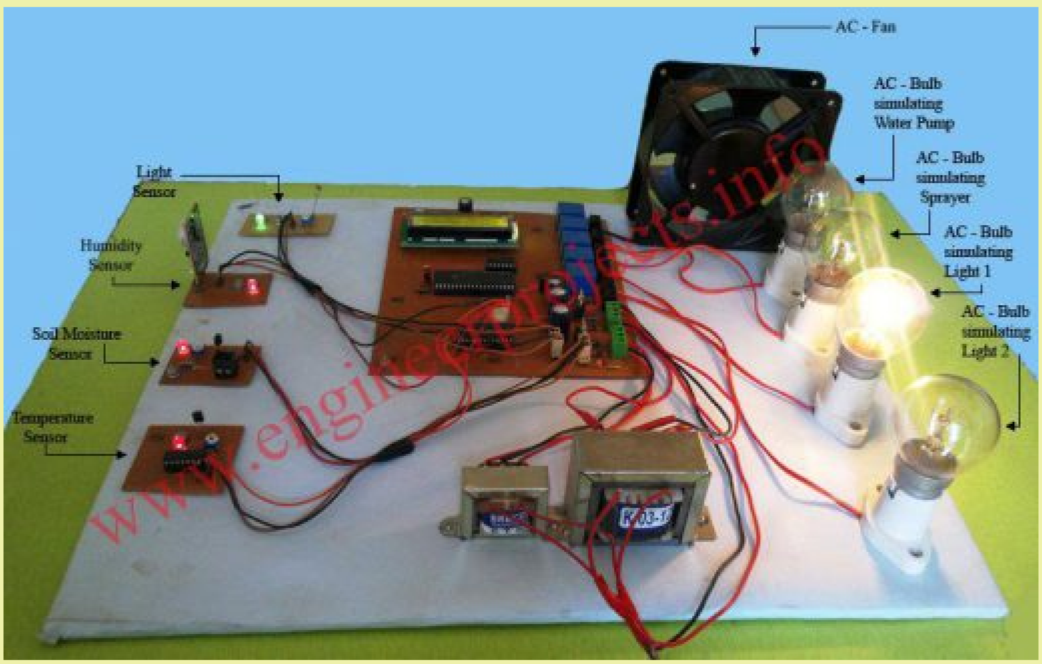


D Mohan Kumar has included a current limiting resistor in this circuit.



This diagram shows why a current limiting resistor is needed. The output is connected directly to the collector of a transistor.

Here's another Indian project:
A GREENHOUSE ENVIRONMENT CONTROL PROJECT:



I don't see any keypad or buttons to change the parameters. What a useless design !!

An email arrived today from a manufacturer of **BATTERY-LESS JUMP START POWER PACKS**.

This is Jenny from **Powerstarter**. We'd like to introduce our **World's First battery-less car jump starters.**

Here is a photo of the supercaps inside the jump starter and the device itself:

If each supercap is about 6,000 F the final value will be 1,000 F. Each cell is capable of withstanding about 2.7v to 3.3v. In this product the cells will experience a voltage of 2v or slightly more than 2v.

This email caught my attention and I replied with some questions.
It took quite a while to get them to admit the product was a supercap storage and there are a number of products like on the market. So, there are not the World's First !!
I asked how much energy the device will store.
Their reply was: **Now each 12V product can store 6627 KJ energy**

I converted this to watt-hrs and replied as follows::

A 40 A-Hr battery has just 40 x 12 = 480watt-Hrs
6627 KJ = 1840 watt-Hrs
A nearly flat 40A-Hr battery will have less than 200watt-Hrs
You only need 12 x 200amps x 10 seconds = 7watt-Hr to help start a car.
Why employ supercaps with 1840 watt-Hrs storage?
It will take more than 90 minutes to fully charge the supercaps at 100 amps and this will be an impossible task.

Their reply:
Our 12V Car jump starter can store 13.5KJ each, as 3.75Whr.

Finally, they admitted their mistake.

A 18650 Li-Ion Cell has up to 6A-Hr capacity and a voltage of 3.7v.

A 3.7v Li-Ion cell holds about 80kJ of energy

The cell stores up to 80KJ of energy.
The supercap Jump Starter stores less than 25% of the energy of a 18650 cell !!

The size of each supercap is not known however from the storage of 3.75W-Hr for a 12v system, we can work out the effective capacitance is 1,130F at 12v.
If there are 6 supercaps in series, each supercap must be 1,130 x 6 = 6,780F

Let's see how a jump starter works.
When you take energy out of a car battery, the voltage decreases.
The voltage of a fully charged car battery remains at 12.6v for at least the first 25% discharge. After that, the voltage drops at a gradual rate.
Some starter motors need 200 to 350 amps and even 450 amps on a cold day.
Some of the newer starter motors have a gear reduction and they revolve at a fairly high RPM with the gears increasing the torque. These types of starter motors only require about 120 amps to 160 amps.
But when a car battery is not fully charged, the terminal voltage drops from 12.6v to as low as 8v depending on its age, the temperature, and state of charge.
This reduced voltage will deliver lower current to the starter motor and that's why the car will not "start."
The battery is capable of delivering a higher current but because the voltage is low, the result is a lower current to the starter motor. If you simply put another battery across the car battery, its voltage will rise due to it getting slightly charged by the jumper battery and it will now deliver a higher current. We haven't charged the car battery, we have simply put a higher voltage across the battery and this raises the voltage of the car battery very quickly.
It's called a FLOATING CHARGE VOLTAGE.

Now let's look at the starter motor requirements:
For a 350 amp starter motor on 12v, the wattage will be 11v x 350 = 3850 watts.
The resistance of the starter motor = 12/350 = 0.034 ohms
When the voltage drops to 8v, the current will be 8/0.034 = 235 amps
The wattage will be 8 x 235 = 1880 watts
The starter motor will have slightly less than half the output power.
This applies to both types of starter motor but the high-current starter motor will be the biggest problem.

The problem is the drop in terminal voltage of the battery.
If the terminal voltage can be increased, a higher current will flow and the starter motor will "crank the engine."

Along comes a JUMP START.
A jump start is the art of connecting another (fully charged) battery across the car battery.
This Jump-Start battery does two things.
It increases the terminal voltage of the system (the voltage seen by the starter motor) and it will supply some of the current.
When the jump-start battery is connected, it immediately starts to charge the car battery and it produces a terminal voltage of 12.6v within a few seconds.
The charging current will only be a few amps and does not come into the discussion.
However the terminal voltage is now 12.6v and when the starter motor is connected, a high current will flow.
The actual value of the current and the proportion from each battery is unknown but the end-result is quite impressive and the car starts immediately.

The supercap starter works on a slightly different principle.
Firstly, the capacitors are uncharged because supercaps have a high leakage and they would be flat after a few months.
So you cannot store the "jump-starter" product in a charged condition.
Secondly, the capacitors present a short-circuit when the jumper clips are initially connected to the car battery and a very high current will flow. And sparks will fly !!
The supercap will charge in a few seconds (up to about 15 seconds) and although this current is high at the beginning, it rapidly drops to a few amps.
Don't forget we are only storing 25% of the equivalent energy of a 18650 cell.
I don't know whether the product has a circuit to increase the voltage of the supercaps above the voltage of the battery, but let's say it does.
The supercaps get charged to 13v.

But a supercap jump starter works differently to a li-ion jump starter.
When you discharge a Li-ion battery, the terminal voltage remains fairly high over the short time-span of starting the car.
But the voltage across a super-capacitor drops proportionally (immediately) as the energy is released.
This means the 12.6v is only available for a fraction of a second.
This means the actual energy in a supercap system is much smaller than any of the figures provided by the manufacturer:

Normally it will take 3 to 4 seconds to start a car,
12V x 200A x 3s = 2WHr
12V x 200A x 4s = 2.67WHr
12V x 200A x 5s = 3.3WHr

These figures may be correct, but the useful energy from the product is not 3.75W-Hrs but less than 1W-Hr because the peak voltage drops off very quickly. .
The product is working on the extreme end of its capability and it would be much better to invest $30.00 in a power pack containing a 12v li-ion battery.
All of the Jump Start devices are working on the extreme end of their capability by delivering 100 amps or more during starting.
Fortunately the action takes place over a few seconds as the battery heats up considerably during this operation.
However the 12v Li-ion pack will allow you to start the car about 10 times before it requires a re-charge and will certainly deliver more than 4W-Hrs per use as the battery holds more than 250KJ of energy.

There is no comparison between the two concepts.
From an electronics standpoint, a supercap product is not suited to this type of application. The voltage on a capacitor drops as soon as energy is taken from it whereas a battery has a much lower rate of drop.
I know manufacturers are desperate to find an application for a supercap, but this is not a realistic application.

This is a $30.00 6AHr 12v Li-Ion battery

This is a $45.00 8AHr 12v Li-Ion battery

This is $110 Supercap Jump Starter.
It is equal to 0.27AHr 12v battery !!

The inside of a supercap Jump Starter.
Note the enormous amount of electronics.

No reply from the manufacturer who wanted me to buy 100 units at $75.00 USD per unit !!

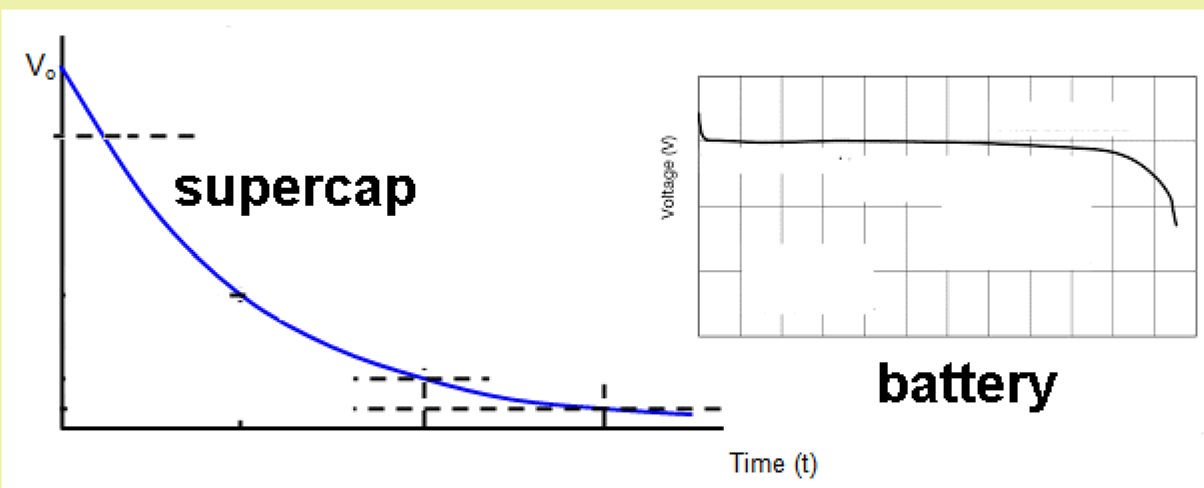
And there is no same product on the market now as the design is fully new.

NO. It is NOT !!! And there are many similar USELESS products on eBay !!

Buy a 4.5A-Hr battery and keep it in the boot of the car. It will cost less than $20.00

WHY A SUPERCAP JUMP STARTER IS SUCH A SILLY IDEA

The following two graphs show how a capacitor discharges and how a battery discharges.



You can see the capacitor discharges to a lower voltage when only a small amount of energy is delivered. This means the actual amount of energy that can be taken from a set of supercap cells is VERY SMALL.
A **jumper battery** will deliver a lot more energy before the voltage drops to a level that is not accepted by the starter motor.
Using a **super-cap jump starter** is just a complete waste of time and money. All the trick in the book will not get

past the fact that is just a waste of time to consider buying one.

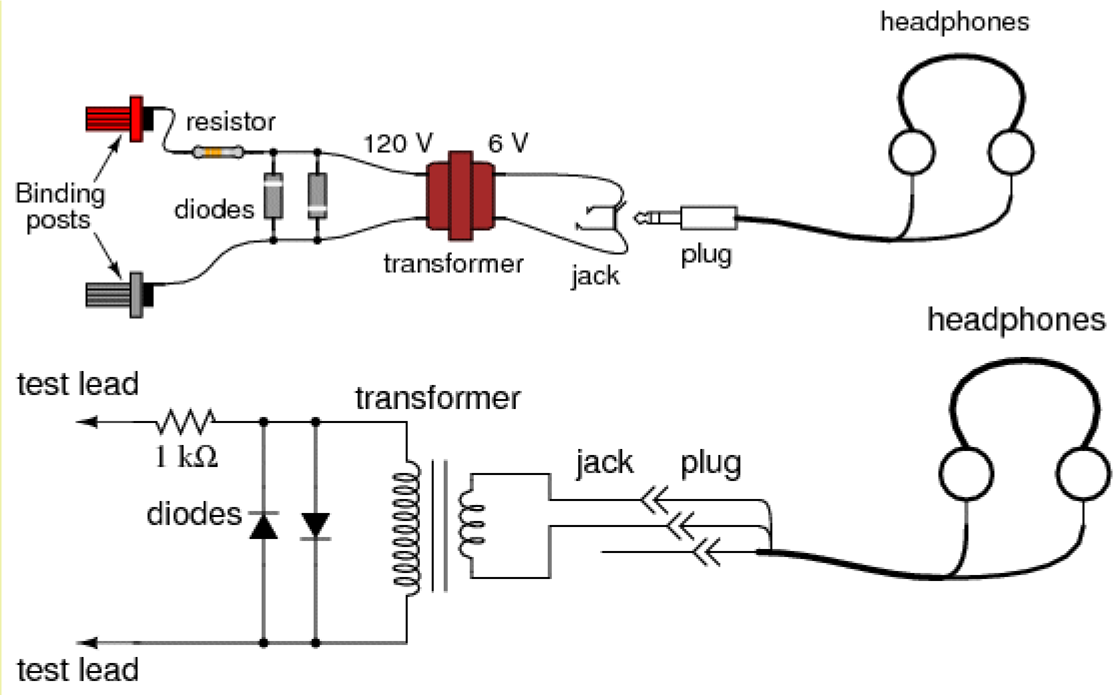
John Darke here in SW Florida with a quick question.

Just got into LEDs with setting up a solar panel with a 12 volt system. We purchased a bunch of RGB colour changing LEDs that were pre-wired (560 ohm resistor wired in series).
We place about 25 of these in series around our pool cage and 6 of them IN PARALLEL inside of a tiffany lamp which also has two 10 watt halogen lamps with a separate on/off switch.
I would love to learn the theory on all of this and your web site looks terrific and I started to read through the LED portion when I came across you section about wiring LEDs in parallel.
Our problem is that 1.) when the halogen lights are turned on, all the colour changing LEDs revert to red and stay red. When the halogen lights are turned off the 25 in series begin changing normally but the six in the Tiffany lamp stay on red and don't change.
Would appreciate your comments as we are having guests fly in a week and hoping to get this thing figured out.
By the way, when I put the Tiffany lamp on an independent battery, the LEDs work properly whether the halogen lamps are on or off.

This problem is mainly due to the voltage required by a LED.
A LED is not a globe.

A LED requires a voltage that is slightly more than the characteristic voltage for the LED. Each colour has a different characteristic voltage that develops across the junction when the illumination is produced.
It is very difficult to deliver this EXACT voltage so we add a resistor and supply the combination with a slightly higher voltage and the LED produces the exact voltage it requires and the extra voltage is dropped across the resistor.
If you increase the supply voltage, the extra voltage will appear across the resistor and this will cause more current to flow and this current will also flow through the LED and increase the brightness.
For 3mm and 5mm LEDs, this current should be between 17mA and 25mA, however it can be as low as 1mA for super-bright LEDs.
In the problem above, we do not know the exact voltage provided by the 12v solar panel and we do not know the current it will deliver.
When a solar panel is in bright light, it can produce up to 50% more than the rated voltage, it just depends on how many solar cells have been included in the panel.
Each solar cell produces about 0.5v to 0.6v and some manufacturers include extra cells so the output will drop to the voltage specified on the label.
In all cases, the output voltage will drop when you take more and ore current.
A solar panel is not a fixed-voltage device. It rises and falls with the intensity of the sun and the load.
However a 12v "string of LEDs" is a fixed voltage device.
The 560 resistor is not 560 ohms but 56 ohms because 560 is printed on the surface-mount resistors and this is read as 56 with no zeros.
When the string is supplied with 12v, the LEDs in the string have individual characteristic voltages.
If the resistor is 56 ohms and we want about 25mA max current, the voltage across the resistor will be 1.4v
This means the total characteristic voltages of the LEDs must add up to 10.6v.
As the supply voltage is reduced from 12v, it drops to a point of 10.6v
This means no voltage will be dropped across the resistor and thus no current will flow.
However, as the voltage drops and the current reduces, the characteristic voltage of each reduces a small amount and the LEDs get dimmer and dimmer. Some LEDs stop working and it appears the red LEDs still give a small amount of illumination.

SENSITIVE AUDIO DETECTOR



This circuit is claimed to be very sensitive and will pick up very faint audio.
This may be true but you have to remember the transformer is reducing the amplitude of the audio to 5% of the original amplitude.
The maximum audio into the transformer will be 700mV (due to the diodes) and thus the output will be 35mV max.
This arrangement is NOT the way to make a sensitive audio detector.
It needs an active device such as a transistor or op-amp to get a really loud output.

But the circuit introduces a very interesting discussion.
Why include the diodes? They simply reduce the output for no reason.
Removing the diodes will increase the output in most cases.
The 1k resistor is intended to reduce the load on the signal but it simply reduces the signal appearing on the input of the transformer by a larger factor than if the transformer was connected directly to the signal.

SOME BACKGROUND THEORY

Whenever you use a piece of test gear, it puts a load on the circuit you are measuring.
The result is the amplitude of the signal is reduced. It may be reduced by 1% or as much as 90% and in most cases you are not aware of the amount of reduction.
All signals have a certain amount of "strength."
This basically means they are capable of delivering a certain amount of current, along with the amplitude of the signal.
We refer to these signals as "strong" or "weak" (or delicate), according the the current they are able to deliver and we can explain this further by saying a 3v peak-to-peak signal developed across a 1k resistor will be "strong" compared to the same signal developed across a 100k resistor.
The reason is this: It will take a flow of 3mA to produce 3v across a 1k resistor, but 0.03mA will produce 3v across a 100k resistor.
This means there will be a flow of 3mA in "circuit A" and if your piece of test gear takes 0.1mA when taking a reading, there will be 2.9mA remaining the circuit being tested.
But if we try to take 0.1mA from a circuit that has 0.03mA flowing, we will reduce the amplitude of the waveform considerably because the signal will not be able to delver the 0.1mA current. We cannot give any absolute values in this discussion but just an idea of what will happen.
Now we take the transformer in the circuit above.
We have already said the diodes are really pointless and now we come to the 1k resistor.
The resistance of the primary winding will be about 50 ohms to 100 ohms but when it is connected to an audio signal the primary will appear to be about 1,000 ohms to more than 4,000 ohms depending on the quality of the transformer.
This is the **IMPEDANCE** or the **VALUE OF IMPEDANCE** or the **IMPEDANCE VALUE**.
If you remove the 1k and the diodes, the input impedance of the transformer will be just about the same as the circuit above (as the 1k makes very little difference to the overall input impedance of the project) and now you will get more of the signal appearing across the primary.

This will improve the audio in the headphones.
By removing the diodes, the audio in the headphones will increase by a factor of up to 10 times and now you have something that will work to detect faint signals.
If you put the headphones directly across the "signal source" you will "kill" the signal.
In most cases the signal will be reduced considerably because the headphones need something like 20mA to 50mA to move the diaphragm.
What the transformer does is this: It converts a high voltage that has very little current-capability to a lower voltage and increased current.
In simple terms, the voltage will be decreased by a factor of 20 and the current will be increased by a factor of 20.
But, although the transformer will be capable of delivering a high current to the headphones, it is the voltage that will determine the actual current that will flow to the headphones.
If the input voltage is 5v, the voltage to the headphones will be 250mV. If the impedance of the headphones is 16 ohms, the current into the headphones will be 16mA. The output of the transformer may be capable of delivering more than 16mA, but the headphones will not "accept" more than 16mA.
This all comes to the important question.
Does the transformer increase the audio? In other words, does it produce a louder result than if the headphones were connected directly to the circuit.
With the 1k and diodes removed, the transformer will put a small load on the signal (compared to connecting the headphones directly to the circuit) and this will allow the amplitude of the signal to be maintained.
It will be reduced a small amount and the actual attenuation will depend on the "strength" of the signal.
But, as we have already shown, a 5v signal will only produce 250mV and only 16mA will flow through the headphones. You will have to try the circuit and see if it produces good results. You can compare it with a single transistor in a common-emitter stage in place of the transformer and work out which arrangement is best.

REMEMBER THIS:

Whenever you use a piece of test equipment, you will not be seeing the absolutely correct and accurate shape of the signal.
This is due to the probe having a value of resistance or impedance that will modify the signal.
That's why you try to use a probe with the highest value of resistance or impedance.
But these pieces of test equipment are expensive.
For instance, a Cathode Ray Oscilloscope (CRO) rated a 10MHz will attenuate the signal and reduce it to 50% when the signal is 10MHz. You only see half the amplitude.
A 30k/ohm analogue multimeter will have a resistance of 300k on the 10v scale and if you are measuring across a 1M resistor, the voltage will be reduced considerably, depending on how the reading is measured.
When you connect a piece of test equipment, the circuit becomes two parallel components. Depending on the shape of the signal and the frequency, the signal can be altered to a point where the circuit stops working.
This can be the case with 100MHz oscillator such as an FM transmitter.
Probing the oscillator with a multimeter will turn the lads into an antenna and draw away so much of the signal that the feedback section will not work and the oscillator will freeze.
If the test gear has a capacitor in the probe, this capacitance may upset the shape of the signal.
When ever you are dealing with weak signals or high-frequency signals, you must remember that probing different parts of the circuit can change its operation considerably.

It actually takes a lot of understanding to "see" what is happening when the circuit above is connected to a project.
That's because it uses a transformer and the windings have two completely different values. Each winding has a resistance, measured in ohms and this can be determined with a multimeter set to Ohm's.
But when an AC signal is connected to the input, the rising and falling voltage produces a back voltage that comes from the magnetism produced in the metal core of the transformer. This voltage can be as much as 99% of the incoming voltage and it prevents current flowing into the transformer. It makes it appear that the "resistance" of the transformer is very high because if we replace the transformer with a high resistance, the incoming voltage would rise and very little current would flow into the resistor.
But we also have a secondary winding and this is connected to a set of headphones. To make it easy we will say the output impedance of the transformer is 16 ohms and this connects directly to 16 ohm headphones.
Now we have a 16 ohm load but we will call it just a LOAD.
When the rising voltage enters the transformer, it produces magnetic flux and this flux cuts the turns of the secondary and produces a voltage and current.
This means some of the magnetic flux is converted to drive the headphones and thus it is not available to oppose the incoming voltage.
This means the opposing voltage will not be as high and thus more current will flow into the transformer.
The amount of current will depend ion the number of turns on the primary winding and the number of turns on the secondary as well as the efficiency of the transformer.
And all this will change as the frequency increases.
So, it is a very complex situation and all you need to know at the moment is the fact that the headphones are a

load on the circuit and they take away some of the magnetic flux, however some of the magnetic flux remains and this opposes the incoming voltage to make the transformer appear to have a much higher resistance - and we call this IMPEDANCE.

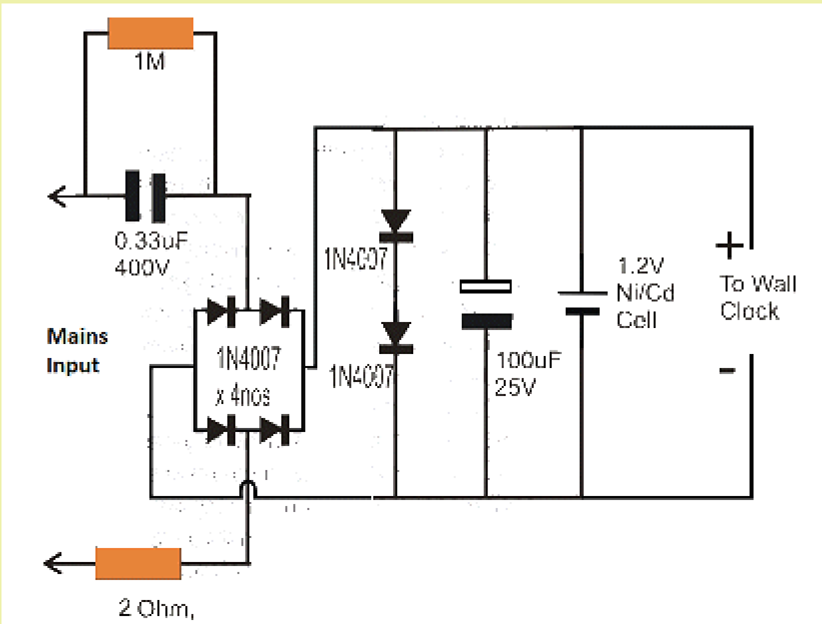
GAMBLING

The internet is full of tricks and "Get-Rich-Quick" schemes that DO NOT WORK.
However the latest craze is to make money on the stock market via buying and selling shares on the short-tem basis.
It is called "leveraged buying" and you put down 10% of the value of the shares and reap the rewards of the TOTAL profit.
It works like this: Suppose a share is $50.00 and you buy 1,000 shares. It costs you 1,000 x $5.00 = $5,000.
Suppose the share goes to $52.00 the next day. You get your $5,000 plus $2,000 PROFIT.
The costs of buying the shares will be about $100 and the cost of the "bank" supporting 90% of the costs of the shares will be about $45,000 x 10% interest x 1/365 for 1 day = $13.00
But suppose the shares fall to $48.00. Your $5,000 becomes $2,887.00 You lose $2113.00 in just one day.
Now you don't have enough money to buy 1,000 shares and you can only buy 577 shares. If the shares rise, you will not get back to your $5,000.
Of course the stock market is rising and it need lots of "mugs" to keep investing to keep it rising.
Even if you have a "seat on the floor" and watch the market go down, you will see the sale of your 1,000 shares depress the market even further and you have no control over the outcome.
If the market drops $5.00, the stock broker will sell the shares for you and you will have to pay the buying and selling costs as well as the "bank interest." You will have LESS THAN NOTHING in a few days. In most cases your shares will be sold at minus $4.50 and you will be out of the market.
None of this is explained clearly to MUG PUNTERS.
You are not "buying shares" you are GAMBLING.
Before you invest ONE PENNY. Look up the share market, select 10 companies and invest $10,000 in each company with MONOPOLY MONEY. Record your profit and loss EACH DAY and come to a conclusion at the

end of 2 weeks.
You must trade EACH DAY because a loss can wipe out a company in one day.
Your $100,000 will be worth less than $80,000 and you will wonder: "WHERE DID I GO WRONG!"
On 50:50 toss of a coin, humans can only get it right 47 times out of 50.
That's why casinos and horse-racing thrive and stock markets make money for the stock brokers.
We can never get passed "47 out of 50" DECISION MAKING.
Try a simple "coin toss" yourself or the "roll of a dice" and if you get 55% or more, you can trade shares.

WALL CLOCK

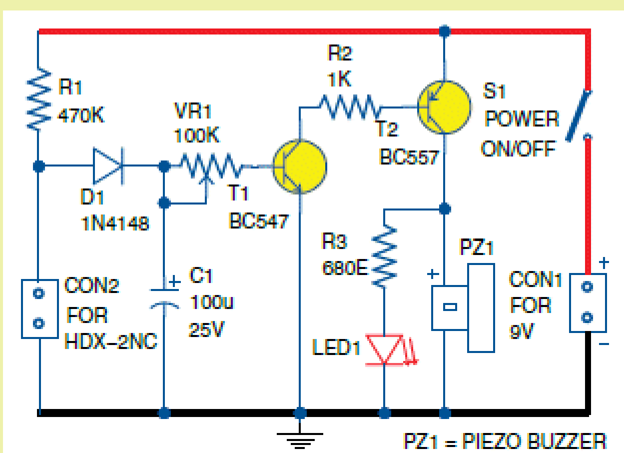
Some things are not worth "electrifying."



The circuit above produces 1.5v for a wall clock.
A 1.5v cell operates for 12 months and it is not worth the effort to convert it to operate from the mains.
But the hidden danger is the circuit is connected DIRECTLY to the mains and anyone taking the clock from the wall can get a shock if they touch any of the electrical wiring.
The 2 ohm resistor does NOTHING to limit the current and the circuit is VERY DANGEROUS.

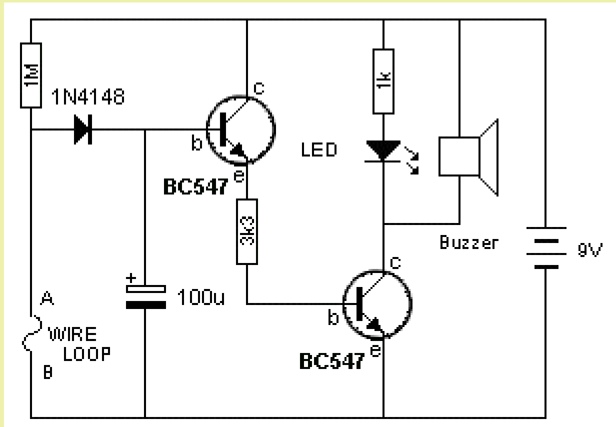
SUITCASE ALARM

Here's another terrible design from ELECTRONICS FOR YOU, November 2016, by Pradeep G:



When the connections in CON2 go open, the 100u starts to charge via the 470k resistor.
But the 470k, diode, 100k pot and base-emitter junction of the transistor form a voltage divider circuit.
Remove the diode and base-emitter junction, and the 100u can only charge to 100k/470k = 21% of rail voltage !

This is 1.9v and the transistor will not work below 0.6v. This give 1.3v range for the delay period.
A very poor design.
In addition, the 1k on the base of the BC546 allows 8mA to flow through the base. You only need 2mA.
As I have said before, there are NO electronics staff at ELECTRONICS FOR YOU to look at simple designs like this and see how poorly they are designed.
It's just a JUNK MAGAZINE.



Here is a simpler circuit that takes half the current when "sitting around" and uses about 40% of the capacitance of the 100u. The 9v buzzer takes between 25mA and 50mA.
The article states: Normally, vibration sensor terminals are shorted internally. When the suitcase is lifted, sensor terminals momentarily open.
There are many different types of vibration sensors and tilt sensors. Make sure you fit the correct type.

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SPOT THE MISTAKES!

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This is the place where I place all sorts of discussions and helpful advice.
I see so many new designs and new components coming from part's manufacturers that I wonder how much is actually "taken up" and incorporated in new designs.
The only way to judge the sales is to look at the inventory provided by wholesalers and see how it decreases over a period of time.
You will get quite a shock.
Some of the newest components sell less than 200 units in 18 months.
And many of these have been given away as free samples.
I have said it before, and I will say it again. Be very careful when choosing components for a project. Many new components are over-priced and and only available from very few stockists.
I learnt this lesson 20 years ago with a 3-tone doorbell chip. It was expensive abut produced a very pleasant tone.
Then it became unavailable. The kit had to be deleted. The same with a speech phoneme chip.
But the embarrassing thing is when you are paying 30 to 50 cents for a chip and then find it is available on eBay for 3 cents !!!
To make money on a project you have to think of a 20 year life-span. That's why you should use tried-and-proven components and source them directly from traders in China or Hong Kong.
Almost everything is available from Chinese markets and the cost will be 10% of wholesale price, with free delivery !!!
The only way to learn electronics is to build a circuit and gt it to work.
To keep yourself active, you have to be doing this ALL THE TIME.
It is pointless putting circuits into simulation programs as the finer details of the operation of the circuit will be missing. Things like motor-boating, feedback, interference between different sections of the circuit will come as a surprise when you actually build the circuit.
The project will simply NOT WORK.

Do you realise the accuracy of all the cheap digital temperature displays are about 1% accurate. If you place 6 different displays in the same location, you will find they vary by less than a degree. How is this possible when they are not "adjusted" (tested) and use 5%

to 10% components. A thermistor is only 5% and when you add all the 1% components, you can get any sort of result.
And yet, in the finish, the result is amazing.
On top of that, the digital temperature meters sell for $5.00 and the single 1.5v cell lasts for 2 years.
It's only when you try to reproduce the circuitry with a microcontroller, do you realise the enormous complexity and skill required to deign the circuit. The major problem is taking a very brief reading every minute because this takes a lot of current.
Talking Electronics has lots of prototyping PC board, matrix board and boards to take all sorts of chips. These will help you build different circuits and make them look neat and professional.
You just have to look at the Indian magazines to see how NOT to put components on a matrix board.
If you are going to make something, make sure it is not an embarrassment when you show it to others.
Look at the PROTOTYPING article on the left column of the website for the range of prototyping boards and you can get a handy pack of components when you visit the **50 - 555 Circuits** article.
I have 3 projects on the go all the time and send a panel to the PCB manufacturers almost every week.

The whole of Talking Electronics website should have been in the form of a dictionary.
I did not think it would grow to thousands of articles and contain so much information.
That's the problem of not knowing the future.
The same occurred with Bill Gates and Microsoft.
He started on a very small platform and his greatest success came from "geeks" who produced programs for MS systems and initially distributed them via Sunday "Flea Markets.
Microsoft systems became the number one seller and clones started to come on the market for under $1,000.
This encouraged Bill Gates to produce the next phase of software "Windows" and he never looked back.
But the whole system was build on a bed of sand and this became evident when trojans from the internet started to infect millions of computers.
Internet data should have been stored in a completely walled section and a window showing what is being downloaded and where it is being stored, should have been included on everyone's system.
But it's too late now. We have to suffer with a system that gets slower and slower as the hard drive fills up with junk and deletions.
I wish I had categorized and tabled everything on Talking Electronics website, so it could be instantly location.
Fortunately w have Google, and this has been done for us. Every paragraph and image has been spidered and can be looked up instantly by creating a Google search.

REVERSE MORTGAGE
Look what will happen to $100,000 borrowed for 15 years @5% as a REVERSE

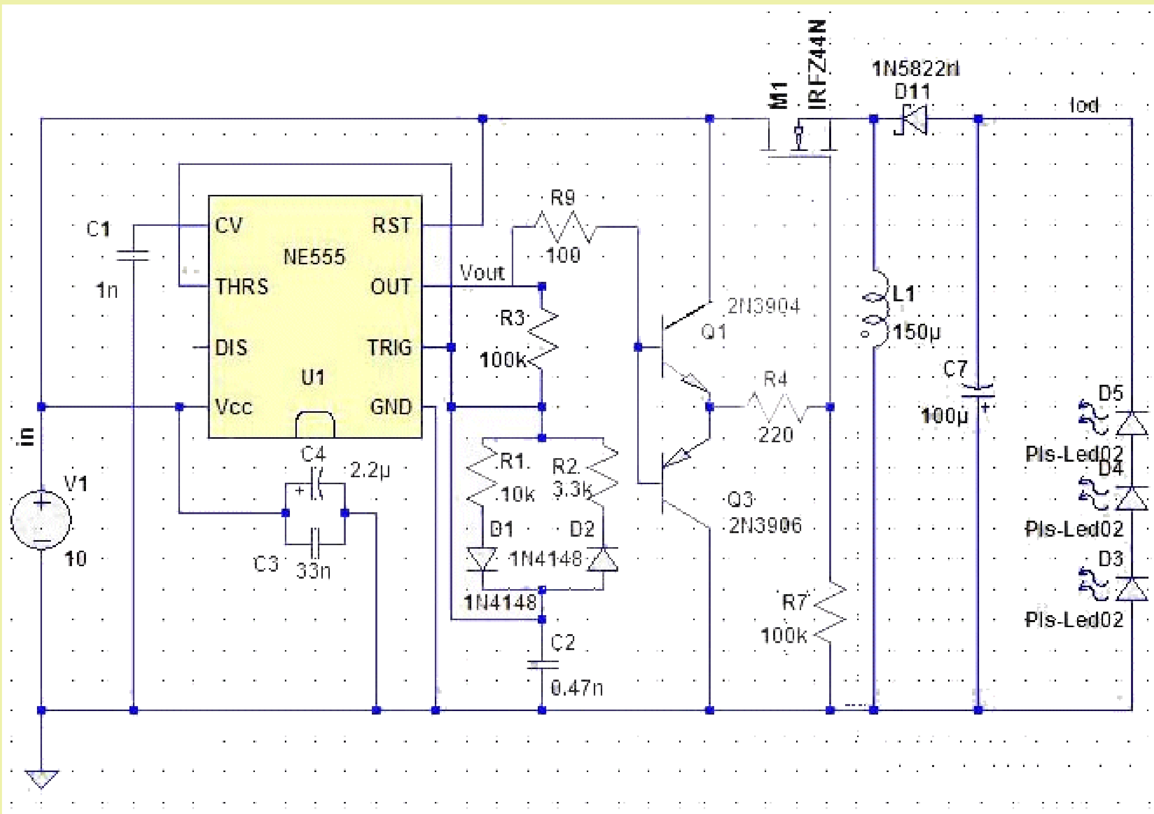
MORTGAGE.
A Reverse Mortgage is when you own your own house and want to borrow money over a long period of time.
The amount you have to repay is quite a surprise because the interest you owe each year is added to the amount you owe and interest is due on the total amount.
This is called COMPOUNDING and is exactly the same as COMPOUND INTEREST.
In 15 years you owe $208,000 !!!!
The only consolation is the value of the house will rise by $200,000 in many parts of Australia over a period of 15 years and you may only lose a small amount.
In some instances you will be able to invest the $100,00 and end up in a winning state.
You just need to realise the implications of compound interest. It adds about 25% to the payback figure.

SUCCESS

How do you measure SUCCESS?
Everyone wants to be successful.
Maybe it's having 6 children, or 3 wives or an enormous house.
Maybe it's having no money AT ALL.
Maybe it's working for the poor all your life.
Maybe it's having all your children take up Law or Medicine.
There are hundreds of ways to rate success.
And not one fits all.
Some want to be hermits, Some want to celibate and some want to fill their house with rubbish.
This is all a form of success to different people.
When it is all boiled down, success is getting up in the morning with a clear conscience, having no debts, having no-one knocking on your door and having no frustrations.
It's fortunate that electronics can provide you with a life that you can enjoy and away from conflict, argument and frustration.
It's the most rewarding career you can be involved in and the most challenging.
If you compare electronics with any other field, you will find it has aided and improved everything to the extent that almost everything is twice the quality and half the price of 10 years ago.
You just have to look at mobile phones, computers, everyday printing, TV's, cars, appliances, and everything else you touch.
The one component that has advanced all these items is electronics.
In 1920 the Patent Office in the US was to be closed down because everything had been invented.
And you are possibly thinking the same now.
If so, you are on the wrong tram.
Just look around you, when you are doing any task and THINK.
There are thousands who cannot do the same task because they are limited in their capability.
What about an aid or a tool to assist them?
What about an alarm, or a motorised device or a computer program.
That's where a combining of electronics and mechanics can create a new invention.
I am thinking of new ideas all the time and that's why I release them, so others can take them up and run with the idea.

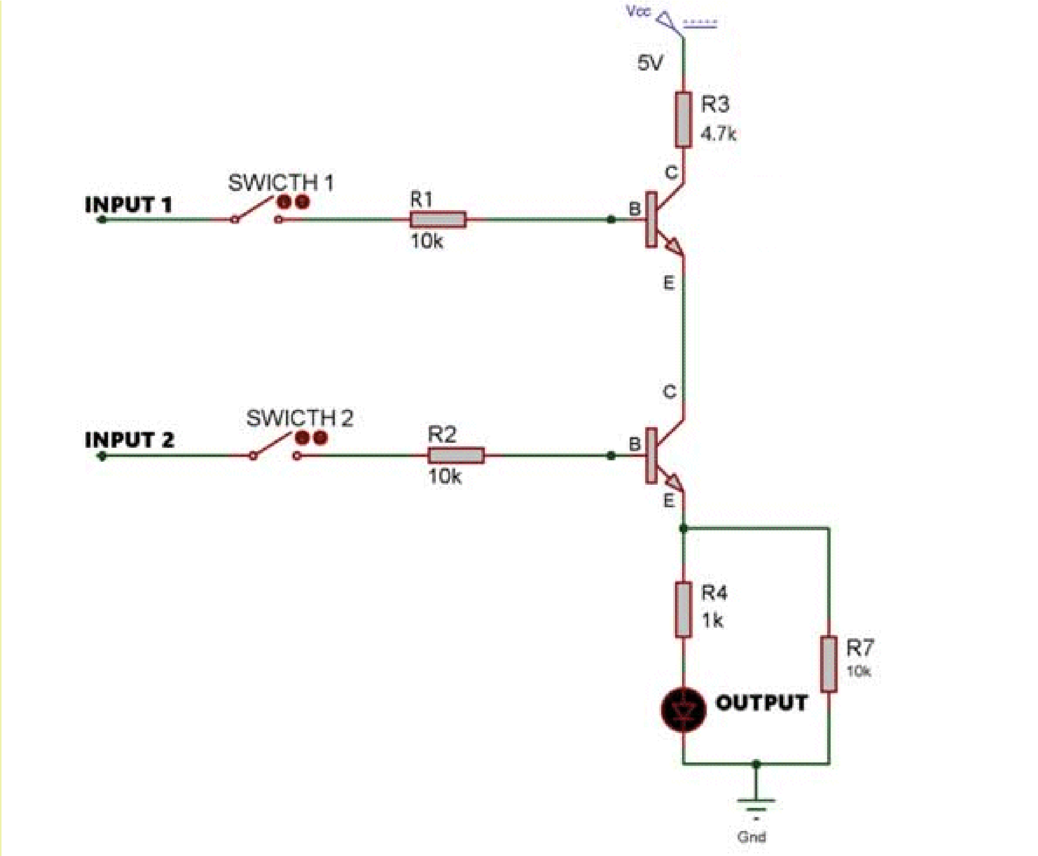
That's what this website is all about.
With 22 million visitors already, we are getting new and old visitors through the site all the time. Some have actually used our circuits to create their own product.
That's what I call SUCCESS.

BOOST CIRCUIT USING 555 IC

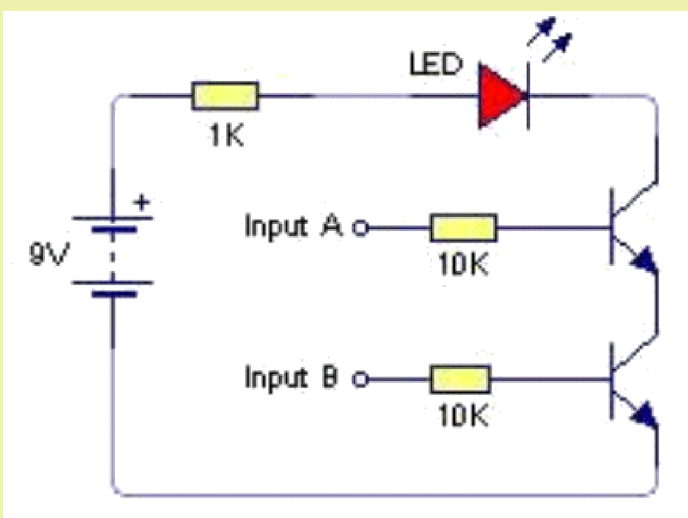


Three mistakes are immediately obvious with this circuit.
There is no current-limiting resistor on the LEDs.
Q1 and Q3 are not needed as the 555 has sufficient driving capability to drive the MOSFET directly.
2u2 on the power supply is not going to be sufficient.
There is a shorting link across R1 and R2 so these components do no change the frequency of oscillation.
R1 and R2 will have no effect as they change the 100k by a tiny amount when they are added.
C1 is normally 10n.
What is the purpose of R7?
By creating a negative output, you don't take advantage of the voltage provided by the supply and the circuit is less efficient.
But the worst part is the layout of the 555.
A circuit diagram is supposed to show the circuit "working" and when the 555 is shown in the way we have promoted it in the 555 Projects article, you can see exactly what each lead does. The 555 block above is a "Layout Block" and you have to take time to work out what each lead does.

Here's another Indian circuit that has not been tested. It is an AND gate:

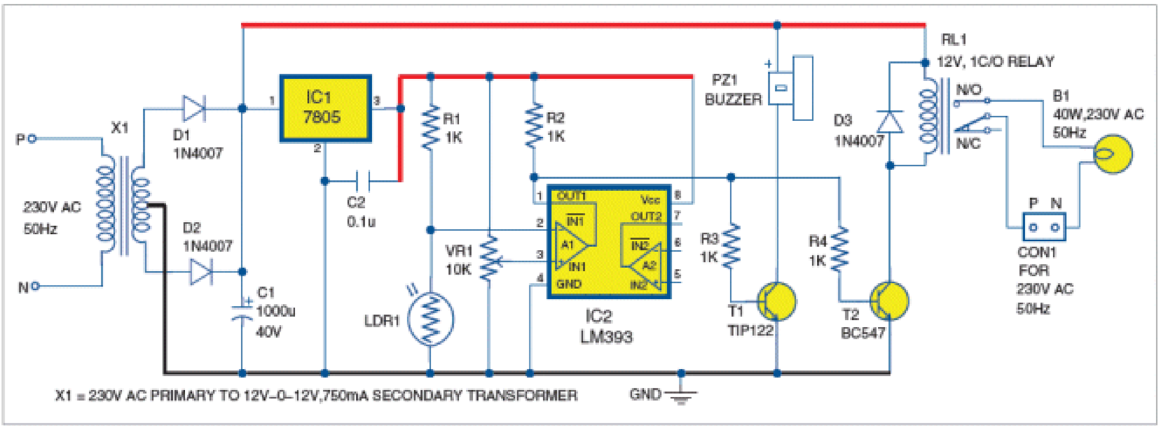


This is a terrible circuit, however if you close swicth !! 2 the LED will turn ON !!
Why?
The lower transistor is an emitter-follower and it will rise so that about 5v is on the emitter, due to the 10k on the base and 10k on the emitter creating a voltage divider. This will give a small current through the 1k to illuminate the LED. The LED will not be very bright but the brightness will not increase very much when the top transistor is turned on due to the 4k7 load resistor.
Here is a simpler circuit that works correctly:



ANOTHER JUNK PROJECT

Another embarrassing junk project from **Electronics For You** January 2017:



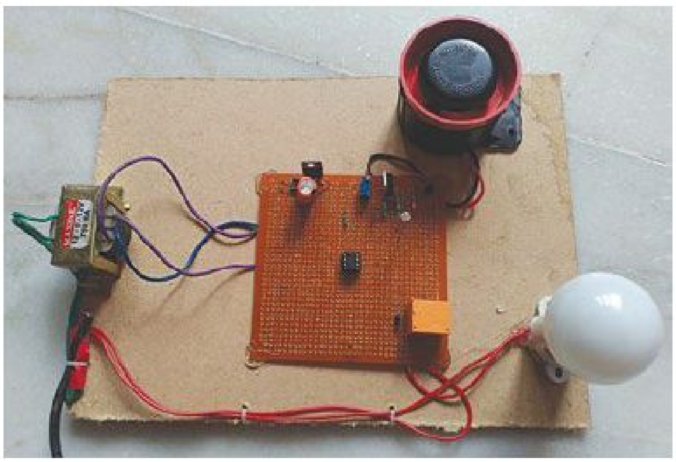


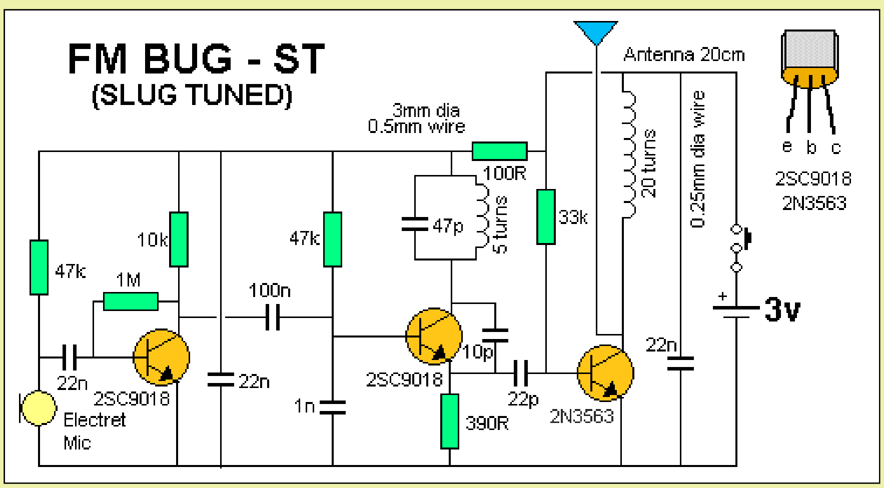
Fig. 1: Author's prototype

The circuit is OVER-DESIGNED.
The Light Dependent resistor can be connected to a transistor and the OP-AMP is not needed.
The 7805 can be replaced by a single zener diode.
The 1N4007 diodes should be 1N4004 as 1,000 volt diodes are not needed.
The TIP 122 is a darling POWER TRANSISTOR. A BC 547 can be used.
Why have two output driver transistors when the buzzer can be connected to the transistor operating the relay.
Look at the prototype. The PCB should be cut to size. I have never seen such as mess. Anyone working in my electronics firm would "get the sack" on the spot for producing a mess like this.
This is the sort of RUBBISH **Electronics For You** puts in their magazine. It shows no quality of presentation and no understanding of how to design and present a project. Mark: 0 out of 10.

The layout above reminds me of many poorly-laid out PCBs.
Talking Electronics made a policy to lay out the components on a PC board in almost the same locations as on the circuit diagram.
This was a revolutionary idea. In addition, all the component values were identified on the board. Previously, all projects in magazines had R1, R2, C1, C2 and you had to refer to the instructions to put the kit together.
On top of this, 90% of the projects had no parts identification AT ALL and it was no wonder very few of the projects were bought and assembled. The board was just blank with lots of holes. Many boards sis not have an identification number and 10 years later you forgot what the board did. Talking Electronics changed all that.
All the other magazines were furious with the concept and tried desperately to kill the sales of Talking Electronics magazine. In the end they all failed and went bankrupt. So much for Karma!!
Here is a typical Chinese FM wireless microphone project.

It is a jumble on the PC board and none of the parts are identified. The designer did not provide any instructions and it is impossible to put the kit together.
Here is a Talking Electronics kit using a similar circuit:

All the parts are identified and the layout corresponds to the circuit diagram.

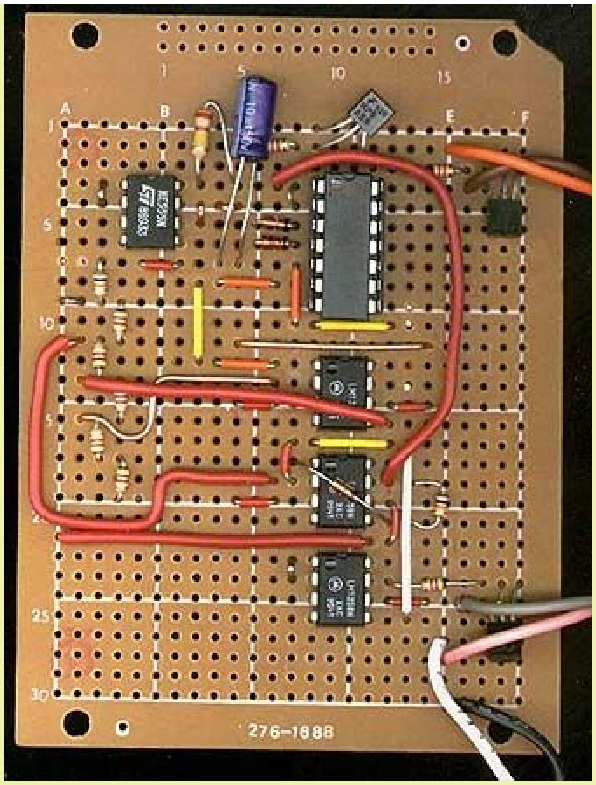


This makes it easy to assemble and easy to trouble-shoot and modify.
All Talking Electronics projects are a LEARNING EXPERIENCE.

Electronics For You Magazine

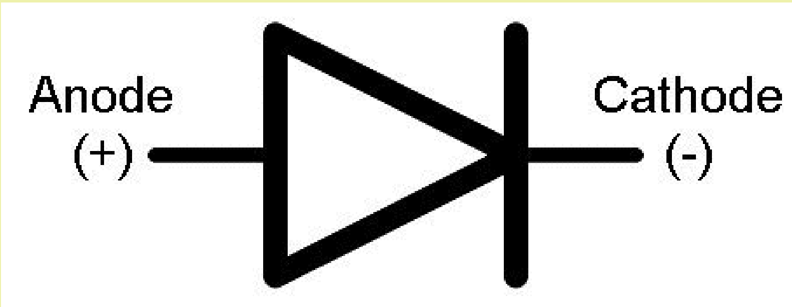
You think **Electronics For You Magazine** is popular !!!!
They are giving it away for FREE !!
The Indians pay 575 Rs for 12 issues and get a free 300 Rs digital multimeter. That leaves 275 Rs for 12 issues. That is 23 Rs per issue. The postage is 50 Rs to 80 Rs per issue. They are losing money on each subscription !!!
The only way they get any subscribers is to give the magazine away at BELOW COST !!!! That proves it is a JUNK MAGAZINE. It doesn't have any worth.
It's just filled with DREAMTIME. Ideas and things that have been pilfered from overseas.
If you look at the University electric car you will see it is way behind the advances of the USA and is costing thousands and lots of time in development. Of course you have to clean up the smelly 2-stroke cars and motor cycles but who is going to pay for an electric car when and improved bicycle could not be afforded by any of the bicycle taxis.

Prototyping:

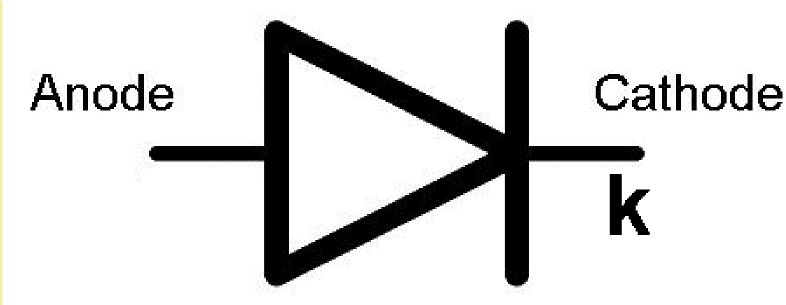


Here is a prototype on Matrix Board.
Firstly, I do not know what pattern of tracks are under the board. The board is so old it is not listed on Radio Shack website.
However the biggest problem with the layout is the amount of board needed. When designing a PCB, the total areas should be as small as possible to reduce costs.
This should be done with the prototype so the position of the components can be transferred directly to the PCB layout to avoid mistakes.
Maybe two of the three 8-pin chips can be moved over to produce a rectangular layout with very little wasted space.
Don't worry about the jumpers. A double-sided board will deal with all the wiring. It is amazing how complex wiring can be placed on a double-sided board.
Just connect everything together with top and bottom tracks and even cross some of the tracks. Then go over the board and gradually fix each of the problems by transferring a track from the top to the bottom and from bottom to top. It is best to place all the bottom tracks across the board and the top tracks from top to bottom.

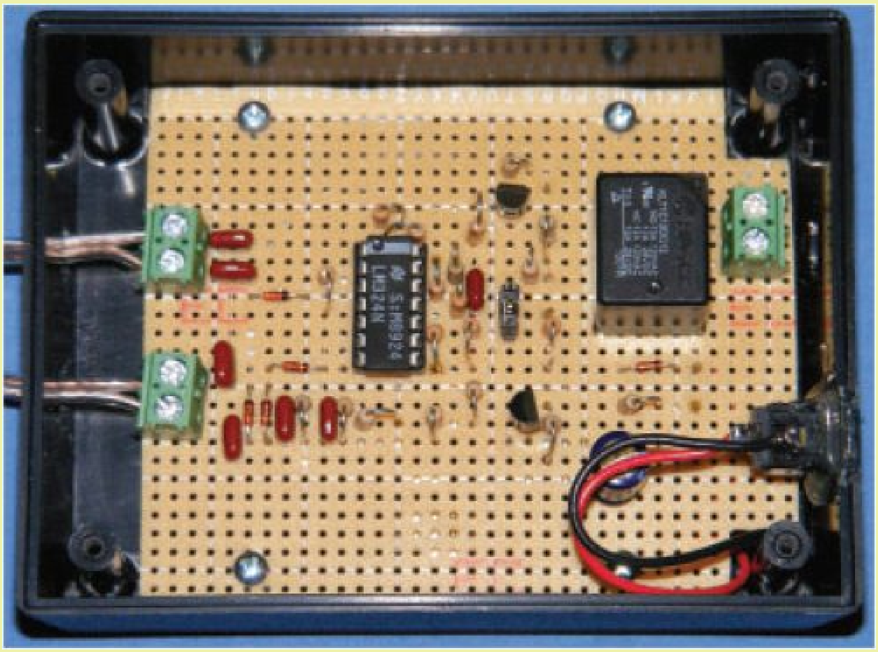
Diode Identification:



Placing "+" and "-" on the symbol of a diode is totally incorrect.
The only acceptable identification for a diode is the letter "k" to indicate CATHODE.
There are many times when a diode is not placed in a circuit with positive on the anode.

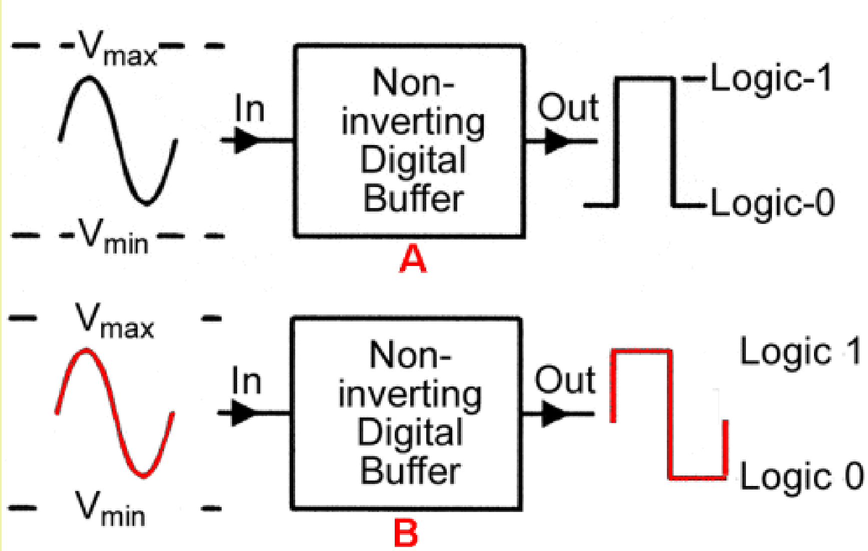


PROJECT ON MATRIX BOARD



Here is another insult to the electronics industry. It comes from an American magazine. The project has been designed on **Matrix Board** and a PCB design has been included in the article, but no photo of the components on the board. The author did not have the intelligence to spend $6.00 and get a PC board made and loaded, before submitting the project for inclusion in the magazine.
Not only is the board poorly laid out, but 50% of the board is unused. After 2 months the author has received only 2 replies - with one asking for a kit of parts. No reply to this question.
I produced a magazine for 20 years and I would not insult my readers with a layout like the one above.

BUFFER

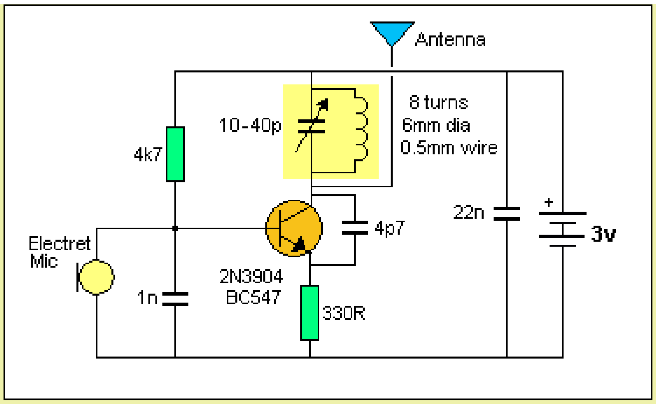


Here is a diagram from a Digital Course. Diagram **A** shows the output of the buffer. But the output is incorrect. The correct waveform is shown in diagram **B**.
How do you expect a beginner to learn if the diagrams are incorrect???

TANK CIRCUIT

One of the first amazing circuits to be "discovered" was the effect of putting a capacitor across a coil in a circuit that is oscillating.
This happened over 100 years ago and the "scientist" (called electrical pioneers or electrical engineers or famous electrical scientists or experimenters or inventors or discoverers) had an oscillating circuit that was sending out magnetic radiation to be picked up at a short distance. The frequency was produced by a multi-pole generator (alternator) and it was before the days of actual electronic circuits. The valve had not been invented and the only semi-conductor was the diode in the form of a lump of crystal (galena) with a very fine wire (called a cat's whisker) touching the sensitive spot on the "rock." Even getting wire to make the circuits and insulating the wire was a new technique with the first wire being simply cotton wrapped or cotton covered.
So, it was really in the early days of electricity and even the torch globe had not been invented.
The main things to be invented at the time were spark coils and capacitors and antenna wires and producing a spark between two balls on the end of two long antennas.
The apparatus consisted of a coil fed by a high frequency voltage and this produced electromagnet radiation into the air. At the receiving end was two antenna wires leading to two balls that were very close to each other. The transmitter would cause a very small spark to be produced by the receiver. The inventor found a coil was needed in the circuit to produce the result he was trying to achieve. The coil consisted of say 100 turns around a cardboard former similar to a jam tin. It was quite a large component.
When a capacitor was placed across the coil, the spark at the receiver increased enormously and if the value of the capacitor was adjusted, the spark became a MAXIMUM.
This was an enormous surprise to the operator as the capacitor was not an "active" or amplifying component and the coil was not classified as an active component.
So, how did the output increase with these two simple components?
We now know and the description of how the circuit works is very complex.
Basically the reason is due to the fact that the two components pass a signal from one component to the other at a particular frequency and this frequency is called the "preferred frequency" or "resonant frequency."
The original circuit produced by the inventor delivered energy to the surroundings over a wide band of frequencies and this caused the receiving signal to be only a fraction of the transmitted signal.
When the capacitor was added, all the energy was concentrated into a very narrow band and the receiver could be moved much further away. The improvement could be 100 times better, or more.
The effect was compared to a tank if water that was filled slowly and a tap allowed a large out-flow when needed.
That's how it got the name: TANK CIRCUIT.

We will use the following circuit to describe how the TANK CIRCUIT works.
You cannot simply pulse the circuit yourself because the pulse of energy must be delivered at exactly the right time and for exactly the right duration.
In the circuit below, the TANK CIRCUIT (shown in yellow) controls the transistor by turning it ON and OFF at exactly the right time so the TANK CIRCUIT gets exactly the right amount of energy for each cycle.



The value of the inductor creates the timing of the first half of the cycle and the value of the capacitor creates the second half of the cycle.
To make these two shapes equal, the time taken to charge the capacitor has to be the same for the magnetic energy in the inductor to be released and passed to the capacitor. In other words, the capacitive reactance of the capacitor (the energy contained in) has to be the same as the inductive reactance of the inductor.
The circuit starts with the 4k7 turning ON the transistor.
At the same time the 4p7 will get fully charged via the 330R and inductor and will have about 3v across it.
The resistance between the collector and emitter leads will reduce as the transistor turns ON and this will cause the voltage across the air trimmer to increase. At the same time the voltage across the coil (inductor) will increase and current will flow through the inductor and produce magnetic flux.
This magnetic flux will cut all the turns of the coil and produce a "back voltage" that will oppose the incoming voltage. This is because we are trying to deliver current through the inductor at a faster rate than it is accepted and the inductor produces a back voltage.
This will prevent a high current flowing through the inductor and in fact almost no current will flow through it.
At the same time the voltage on the top lead of the 4p7 will decrease and since the 4p7 is charged, the lower lead will also drop in value. This will lower the voltage on the emitter of the transistor.
There are two ways to turn a transistor ON. Either increase the voltage on the base and keep the emitter from moving or lower the voltage on the emitter and keep the base fixed.
That's what happens in this case. The 1n capacitor on the base keeps the base fixed at the frequency at which this circuit operates and as the collector voltage drops, the emitter is pushed towards the 0v rail.
At the same time the 4p7 is discharging and while the transistor is turning on more and more, the above conditions apply.
But a point comes when the 4p7 is fully discharged and the transistor is turned on a fair bit but it is not turning on any more. We don't know the voltage across the air trimmer but the inductor will have the same voltage across it and it will be producing the maximum amount of EXPANDING FLUX. But the rate at which this flux expands is getting less and less because the transistor is turning on more and more but at a reduced rate.
Eventually this rate drops to a point where the circuit cannot deliver expanding flux becomes stationary flux and then it starts to collapse. The collapsing flux cuts the turns of the inductor and produces a voltage in the OPPOSITE DIRECTION. This voltage discharges the capacitor and it keeps delivering energy to the capacitor to charge it in the opposite direction.
The voltage on the collector of the transistor rises and the top lead of the 4p7 rises and the air trimmer starts to charge. This pulls the bottom lead of the 4p7 up and the emitter rises too. The reduces the voltage between the base and emitter leads and it turns the transistor OFF. The transistor effectively disappears from the circuit and the voltage on the lower lead of the air-trimmer rises and can rise to a voltage higher than the 3v supply.
The magnetic flux (energy) charges the air trimmer and 4p7 and eventually the 4p7 is charged and it no longer keeps pulling the emitter lead "up."
The voltage on the emitter lead reduces and the voltage between the base and emitter increases and this starts to turn ON the transistor to create the next cycle.

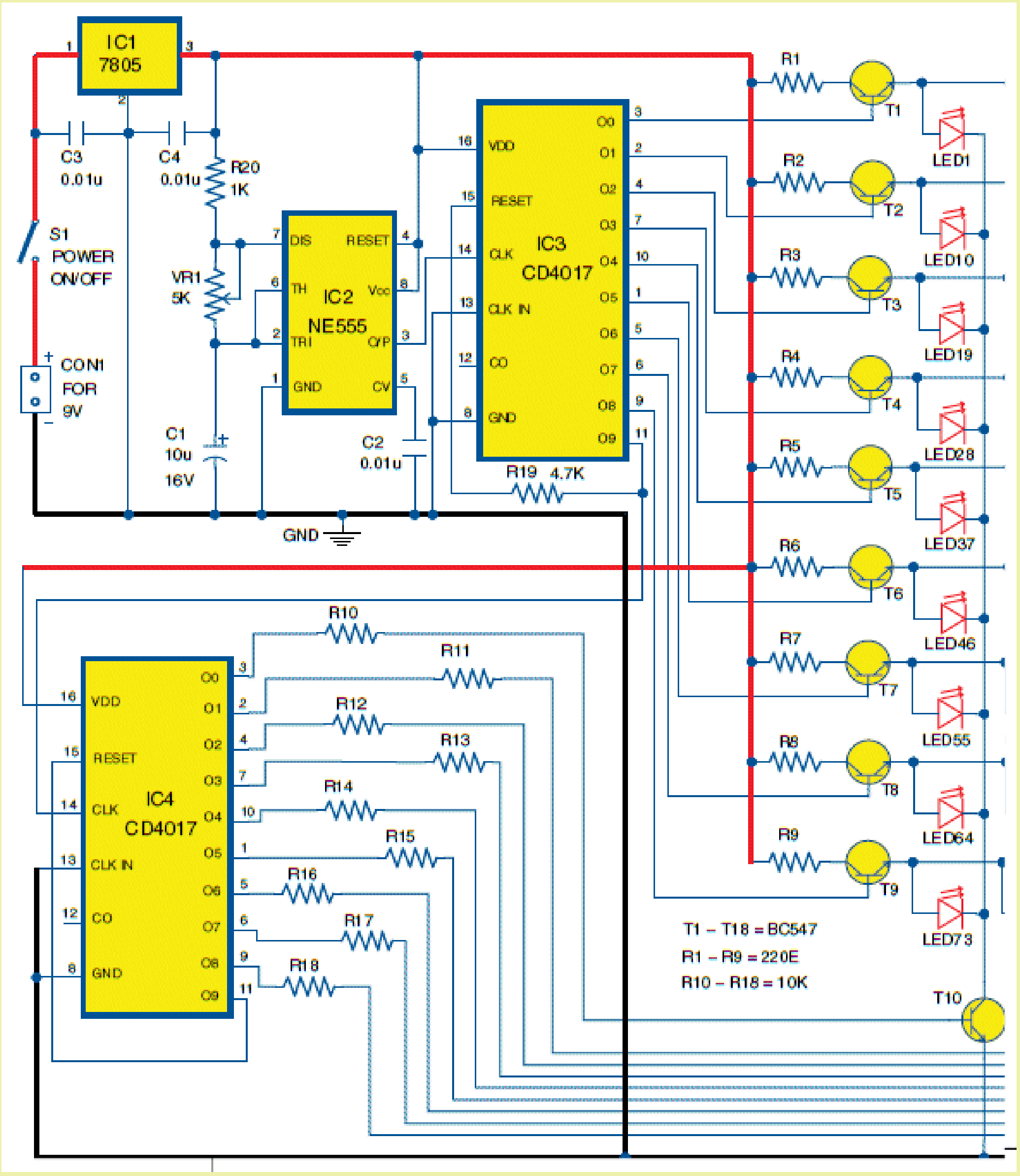
RUNNING LED

Here is another junk circuit from **Electronics For You** February 2017:

It has 81 LEDs in 9 rows and 9 columns.
The LEDs are turned on ONE AT A TIME and this means it takes 81 cycles before the first LED is illuminated the second time. You can imagine how dull the screen will be with a terrible scanning like this.
But the biggest technical mistake is the 220R (R1) in the collector of the first transistor.
When T10 turns ON, the voltage on the top (anode) of the LED will be 0.5v + 2.3v (for a yellow LED) = 2.8v.
The emitter will not rise above 2.8v and thus the base will not rise above 2.8v + 0.7v = 3.5v.
But the 4017 will try to pull the base up to about 4.5v as the base is connected directly to the output. So we have a conflict.
What happens? Current of about 5mA is delivered to the LED via the output of the 4017 and the voltage on the output drops to about 3.5v
A current of about 10mA will flow through the 220R resistor but the whole circuit is badly designed. The transistor is turned ON fully, but the base should not draw current when in a correctly-designed emitter-follower circuit. A very bad technical mistake. The 220R should be in the emitter lead.
The "Assistant Professor" has absolutely no ideas about electronics.

It was designed by:
Pamarthi Kanakaraja, assistant professor. Usha Rama College of Engineering and Technology, Andhra Pradesh India.

I pity all those students going through any of his courses. You should demand your money back.



BATTERY CHARGER

Here is another bad circuit from **Electronics For You** February 2017:

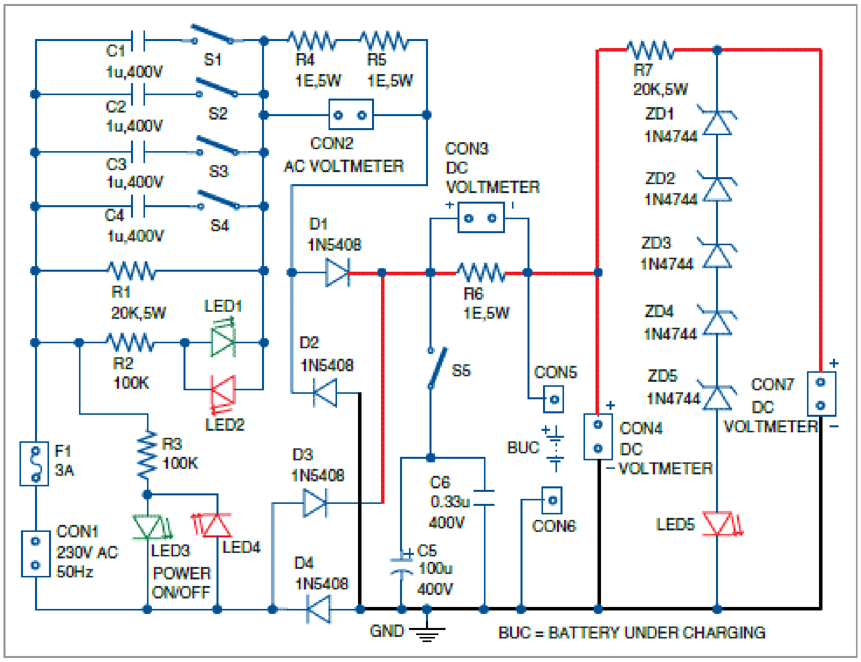
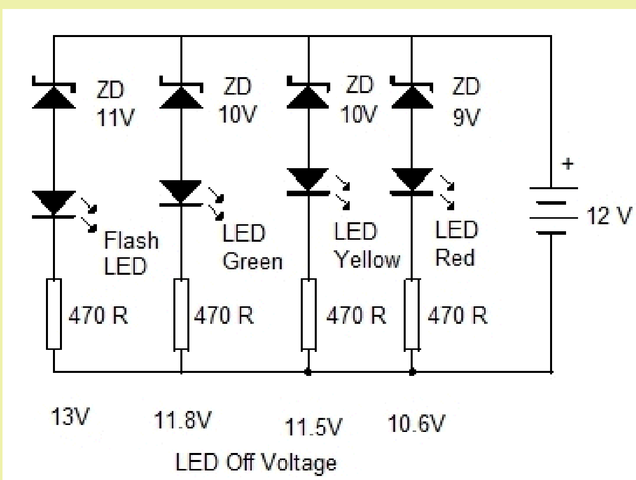


Fig. 1: Circuit diagram of the simple low-cost and versatile battery charger

It is a battery charger that is connected directly to the mains.
This means it will have leads and alligator clips exposed, with 300v potential.
But the real issue is the 1R resistors. What effect will they have on protecting ANYTHING?
What voltage will appear across the connections of CON2? About 2v What will this tell you????
What voltage will appear across the connections of CON3? About 2v What will this tell you????

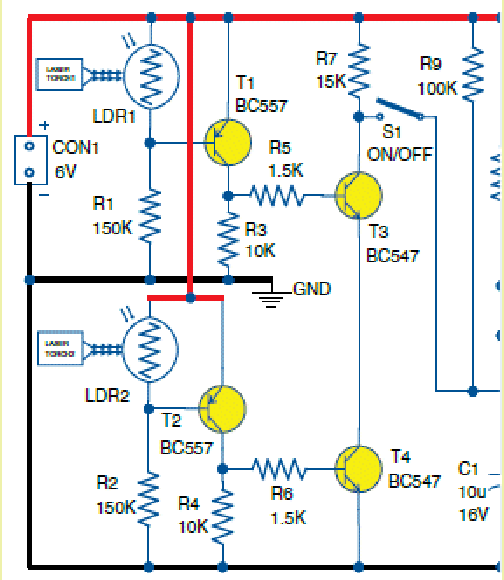
LED VOLTMETER

Another untried circuit from "Professor" Mohan Kumar:

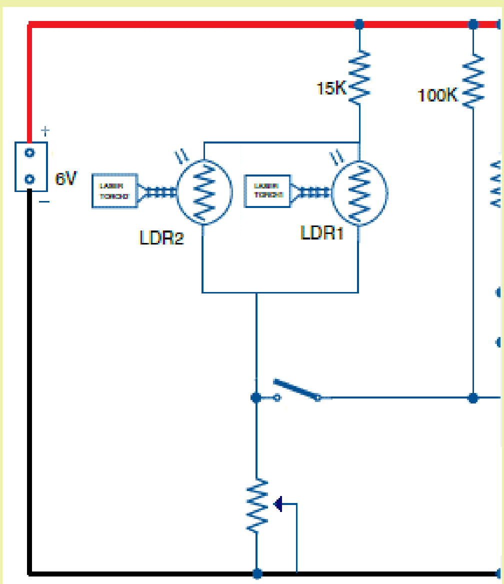


Some LEDs will come on at a voltage lower than the recognised "characteristic voltage" but you cannot take this into consideration when designing a circuit.
Take the green LED for example. 10v is dropped across the zener and 2.3v across the LED. But the LED will not illuminate when the supply is 12.3v because there is no voltage across the 470R and thus no current will flow. If we increase the voltage to 13.3v, 1v will be dropped across the 470R and 2mA will flow. Thus the value of 11.8v on the circuit is incorrect.
Obviously he has not tested the circuit and we have proved he never tests any of his circuits. He just puts them out and makes a fool of himself. He is the worst design-engineer in India. None of his circuits work.

LASER RECEIVER

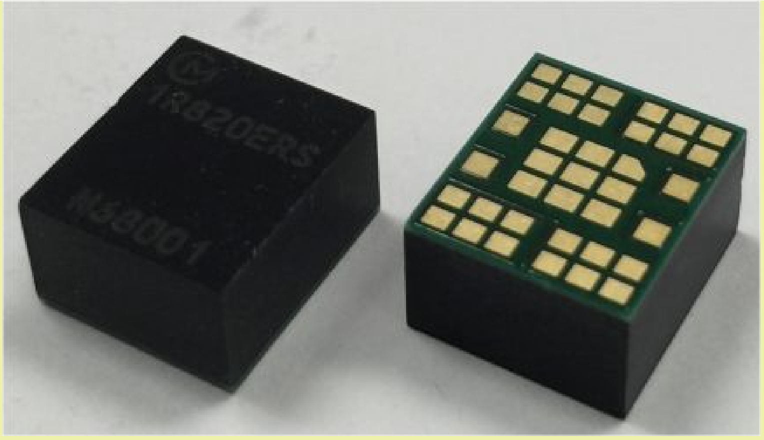


The secret to being a good design engineer is knowing how and what to design and the characteristics of each of the components you are using.
In the circuit above, the the two LDRs' can be connected directly to the 555 without any transistors. This is something the two design engineers should have done before putting the project into **Electronics For You.** But neither the magazine or the two students are qualifies to do this research and that's why the magazine published such junk projects.
The circuit below will achieve the same result as the one above:



Two laser beam are focused on the two LDR's and when an object passes both beams at the same time, the alarm is activated.

SURFACE MOUNT DC to DC "CUBE"

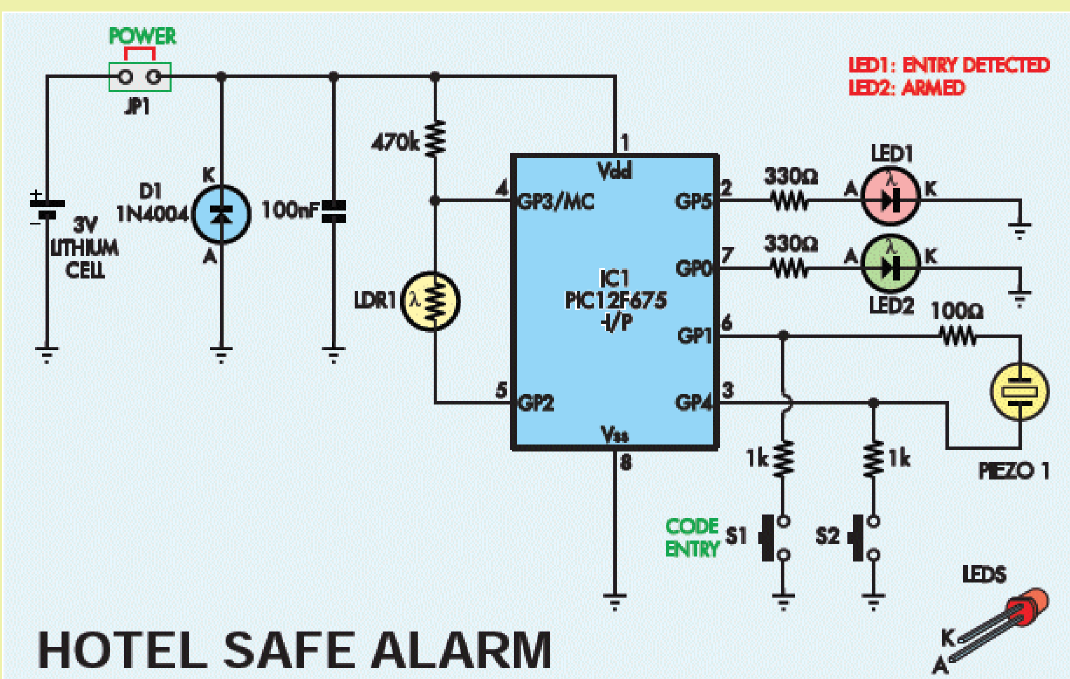


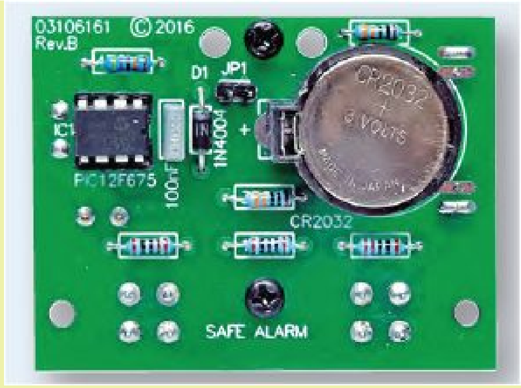
Here is the latest DC to DC "cube."
It might be a wonderful design but mounting it on PC board for a prototype will be very difficult.
And diagnosing any problems when the project is ready for shipping will also be be a disaster.
You cannot get to the pins under the cube and you don't know if they are all soldered correctly. You don't know were a problem will occur.
You are just asking for trouble when you include a component that you cannot thoroughly test and check. There are plenty of DC to DC converters and if you have to use a through-hole component, it will be a hassle-free alternative.
There are two more pointers you have to take into consideration.
Recently introduced components are very expensive and may be in limited quantities. But more important is the fact that many of these items go out of production and you are left with a product that has to be re-designed. This has happened to the author on many occasions and has terminated a good-selling kit.

ALARM

Normally I don't find much to highlight from Silicon Chip Magazine because they don't produce much in the way of basic projects. But when I offered to supply them with FREE projects each month, they flatly refused the offer, basically they knew I had a very large following and they were afraid I would "steal the show." They have not produced a singe simple project for beginners for the past 5 years and it is no wonder their sales have dropped to less than 6,500. It is probably much less than this because the local shopping centre sold 105 copies per month and now they sell 15. And all the sub-news agencies have gone.
However they manage to scrape by, by selling all their content to Everyday Practical Electronics in the UK and it is dumped in their magazine, exactly 12 months later !!
Silicon Chip tried to make some vague stupid comments about a couple of my projects and that was when I suddenly realised Leo Simpson had absolutely no understanding of electronics. And when I contacted a number of acquaintances, they confirmed the fact that he has never presented anything technical. How you can run an electronics magazine and not know anything about the content. This is a skill of deception.

Here is a project that shows a complete lack of understanding:

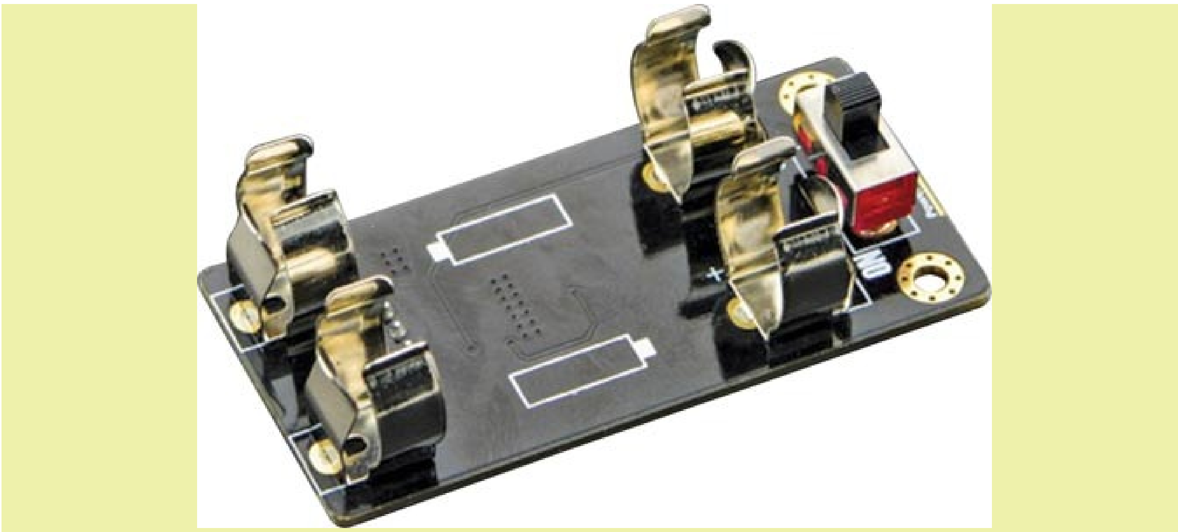


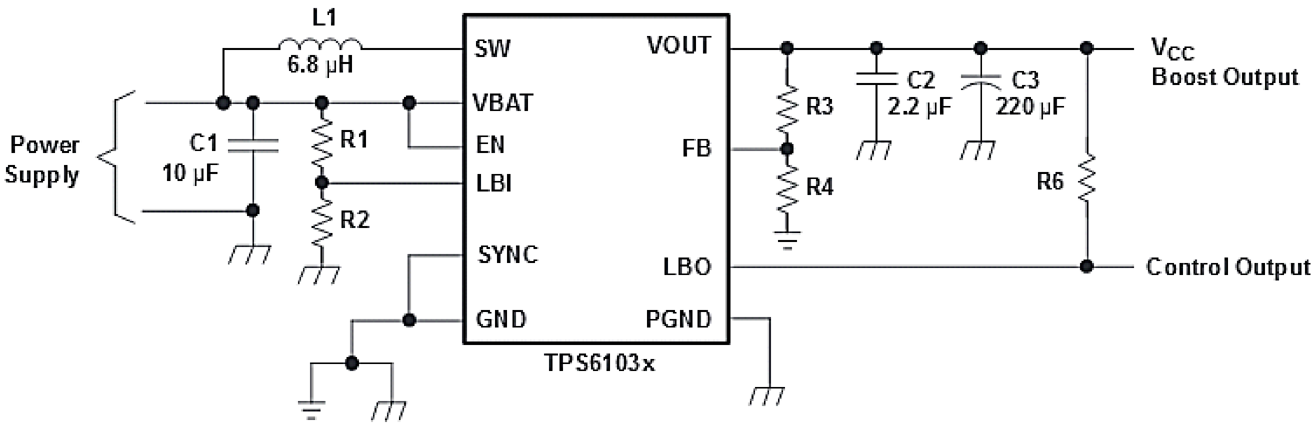


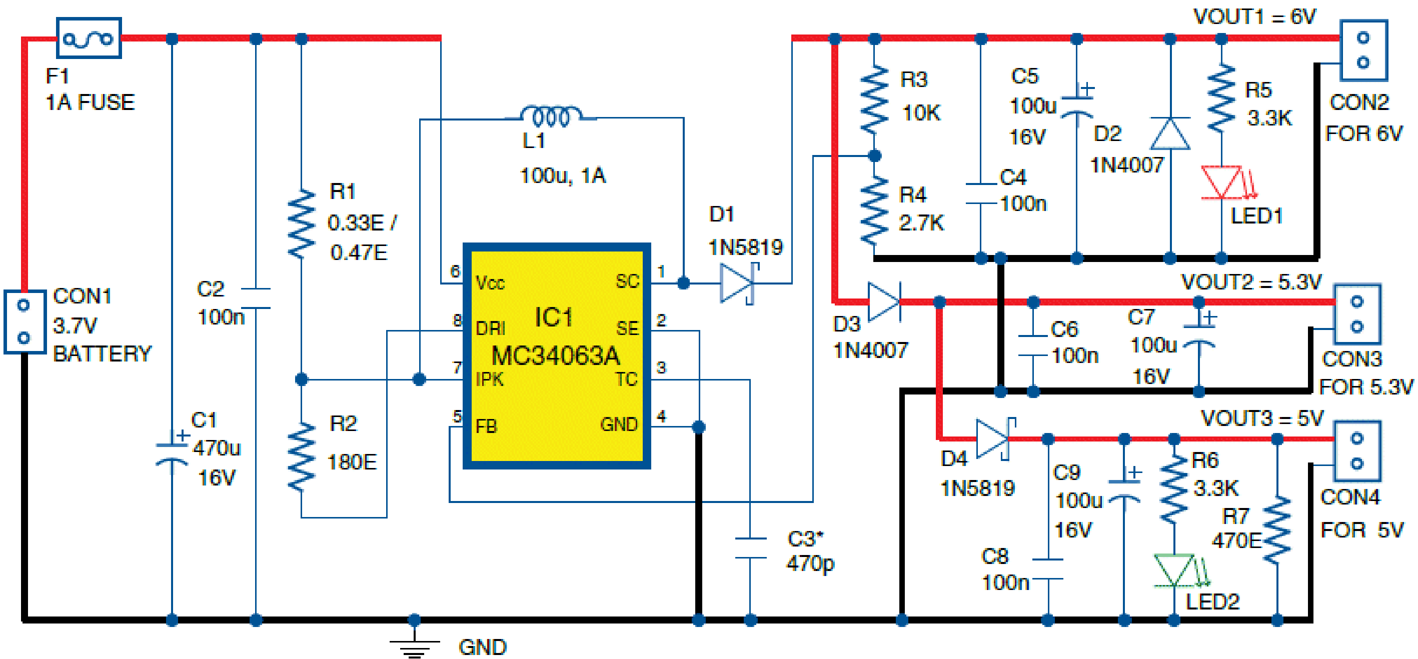
The piezo has less than 5v across and its output will be similar to a MUSICAL BIRTHDAY CARD.
I tried 11v on my HANDY TIMER project and you could not hear the beep in the next room. I added an inductor and now you can hear the beep with the door closed !!
I used the push-switches shown in the photo above in some of my projects 15 years ago and they are such poor quality they don't make contact after a few presses. They are RUBBISH !
Silicon Chip have always used 1% resistors and they cover up the value on the PCB so you don't know if the correct resistor has been fitted. They obviously don't get any feedback from readers, because this absurdity has been dished out for the past 20 years.
And when you go to the EPE PCB website, the PCB is not yet available. The website is 2 months behind !!!
When you go to the Silicon Chip website, they want $5.00 for the PCB and $13.00 for the chip. Imagine how much the whole kit will cost by the time you pay delivery costs from 3 different suppliers !!!
Then you look at delivery time and find they have NO PCB's IN STOCK !!! What a joke.
Now you can see why they hated TALKING ELECTRONICS. I provided same day service to over 250 kits and sold more than 300,000 kits over a period of 25 years.
No magazine offered anything like the service, feedback, reliability and back-up.
Talking Electronics is the only website with backup and assistance to all the kits they have designed. And no-one has complained about the price. If they do, they get 1kg of kits on their doorstep, FOR FREE !!

WHAT !!!!

Here are two projects that convert 3v to 5v.
They might be very clever and save one or two cells, but a cell costs less than $1.00 for 1.5v and $2.50 for a 3.7v cell.
To produce 5v, you just need 4 AA cells and a diode. This will reduce the voltage to 5.4v and the voltage will drop slightly as the cells get used.
The project below costs more than $12.00 and $8.00 delivery, just to get 5v from 2 cells.







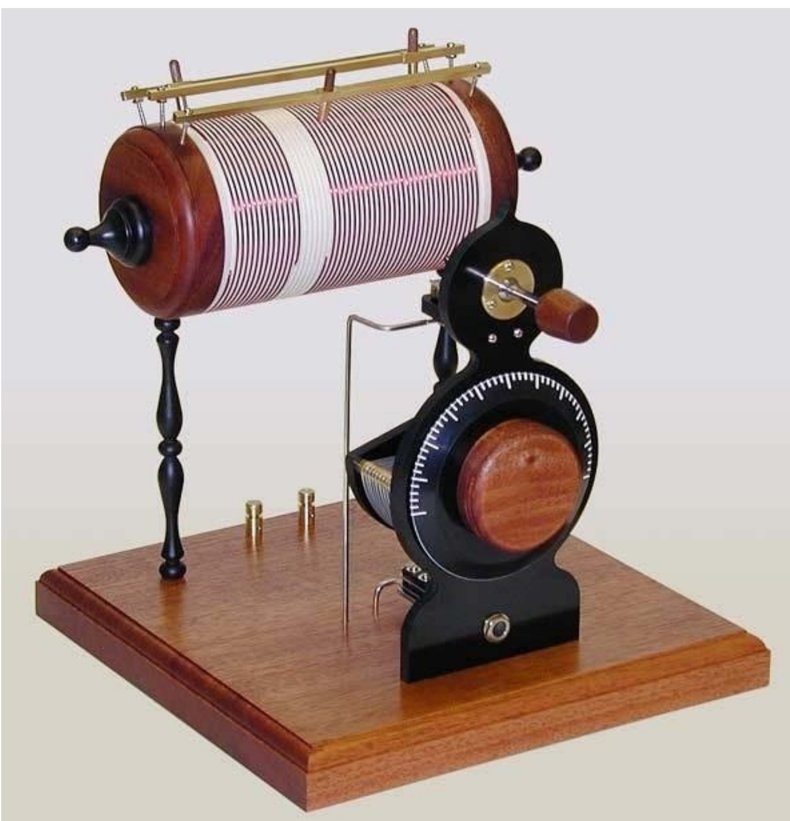
I use a 6v battery-box with a switch and a diode to get 5v. This costs less than $3.00.
The 3.7v Li-Ion cell can be used to produce 5v, if two cells are placed in series and 3 diodes are connected in series to reduce the voltage to about 5.3v A small amount of energy is wasted, but it is much cheaper than adding all the circuitry above.
The whole skill in electronics is doing things as cheaply and efficiently as possible.
Some of the things that have been simplified, have amazed me.
The Garrard turntable with all the levers and arms was simplified to a cam mechanism and one lever.
The key-finder was simplified from at least 12 components to a single chip and the mobile phone has been simplified from 1,000 components to a few large scale integrated circuits.

HOW TO

The Complete Guide on How to Build a Crystal Radio—Plus How They Work

BY AUSTIN SIRKIN 01/03/2013 6:04 PM

There's a lot that goes into making a nice crystal radio set, so this is going to have to be broken down into two parts. The first part is the actual making of a functional radio, and the second part is making the whole arrangement look nice. In this part, I'm actually going to tell you more than just how to make a crystal radio, but I'm also going to explain how and why they work.



Crystal radios are pretty Steampunk in and of themselves, since they were first developed in the late 19th century. The technology was discovered in 1874, though it wasn't put into commercial use until the very early 20th century. The great thing about a crystal radio is that it doesn't need a

the power it needs is picked up from the antenna. As a result, most simple sets are pretty low-volume, but they rk just fine!

Overview

For those of you who aren't tech-savvy, this project is really, really easy. Anyone can do it, provided that you have the right parts. Here are all the parts you need to make a crystal radio, and I'll explain what they are, how they work, and where to get them:

You may notice that there are only four parts. Yeah, that's really all you need!

Before I get into explaining what they are and what purpose they serve, let me tell you a little bit about how the whole arrangement works.

With a crystal set, it's important to have an antenna. Your coil (which I'll be talking about later) can function as sort of an ad-hoc antenna, but for the best results, you need a good antenna. The reason you need a good antenna is because the more antenna you have, the more power your set will receive, and the louder it will be.

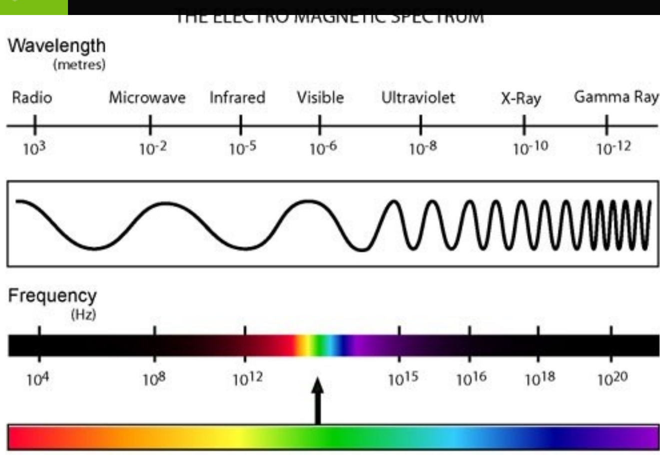
That's because radio waves are, for all intents and purposes, wireless power. Yes, the invisible waves that constantly surround and penetrate you are strong enough to power a simple radio.

How Is That Possible?

Some of you may be familiar with Nikola Tesla's experiments in providing the world with wireless power. Well, "power" can mean a lot of different things. We often think of electricity as water, flowing out of our electrical sockets as needed. In reality, it's a lot more complicated than that, and like water, electricity has waves, currents, and other characteristics that govern its various attributes.

While you may think of radio waves and electricity as being different, they're actually the same phenomenon! Radio waves are just fluctuations in the electromagnetic fields that surround us at all times. Think of the waves in the ocean: they can push you around because each wave has its

kind of think of radio waves like invisible ocean waves. They're invisible to us, because they don't react with us. ...er, a copper wire can "see" the waves because it's a conductor of electricity!



You can essentially think of the waves as vibrations. When they hit a conductor, they make the conductor vibrate. In this case, the vibrations are so small that they're almost impossible to hear. That's why you need a crystal (or diode) to adjust the signal, and then a very, very sensitive earpiece to hear it. When you use a powered radio, it adds that power to the circuit, amplifying the vibrations until they become quite loud. That's what the battery (or plug) does. No matter what kind of radio you have, it's always picking up the radio waves, even when the power is off. You just can't hear them unless you're amplifying the circuit because of the way modern radios are built.

Now that you have a general idea of the principle behind a crystal radio, let's look more specifically at the parts and how they work.

The Wire

Not to be confused with the television show of the same name, the wire is the skeleton of your radio. Your wire is going to serve two purposes:

1. It will "catch" the radio waves
2. It will allow you to tune the radio

The radio wave catcher is known as your antenna, and the tuner is known as your coil. There are many configurations for both of these, but I'm going to cover it as simply as possible.

First, what kind of wire should you use?

Well, that's a hard question to answer, because each type of wire has plusses and minuses. Generally you'll be dealing with two different types when it comes to crystal radios, insulated wire and magnet wire. For all intents and purposes on this project, insulated wire and magnet wire are the same thing. It doesn't matter which you use, though you can see in the picture below that I used magnet wire.

as that it looked more "steampunk". Plastic insulation is pretty

ent with a 16 gauge for mine, but I recommend slightly
t it's largely a matter of whether you prefer to work with a
wire you go with.

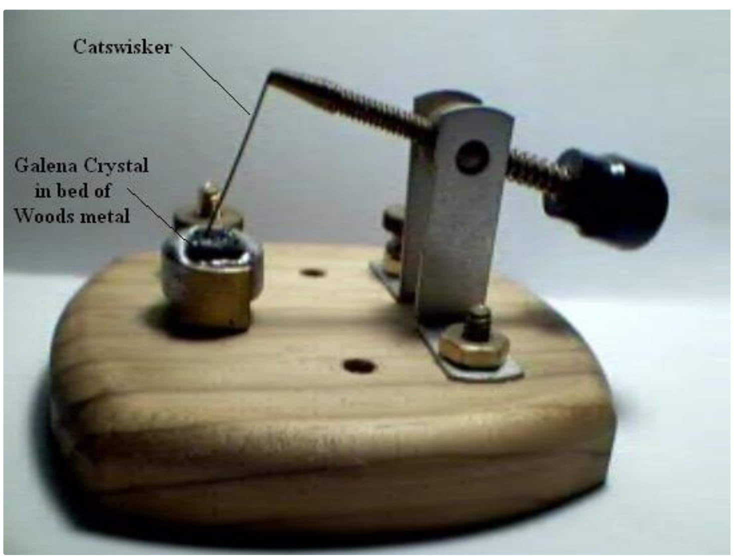
We'll talk about what exactly to do with this wire later on.

Crystal / Diode

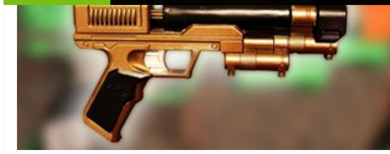
When I first set out to make a Steampunk crystal radio set, I thought to myself, "Yes! I will find a real crystal for my radio, and it will be super authentic and awesome-looking!" That enthusiasm died out pretty quickly, unfortunately, as I came to learn exactly what was entailed in using a real crystal.

The crystals you can use for a crystal radio are pretty limited, and it's not like you can just hook it up to a piece of quartz. Most of the crystals that are useful for a radio aren't ones that look particularly pretty, such as galena, which is a crystal form of lead.

Second, tuning them is a gigantic pain in the rear. A crystal radio that uses a real crystal is called a "cat's whisker" set, because of the way that the wire dangles over the crystal. Essentially, you need to constantly hand-tune them while you're listening, or else you'll lose the signal. It's terrible.



enticity, I had to compromise for the sake of not pulling my hair out and just use a modern diode. "Modern" is
he design of the modern diode hasn't changed significantly since 1930. While I could potentially have used a
der to come by and still slightly past the Steampunk era. I may continue to look for one, though.

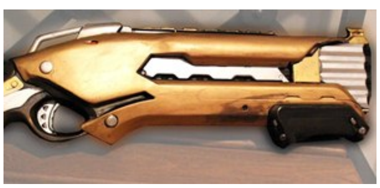


HOW TO

The Easiest Way to Paint a Steampunk Nerf Gun (No Disassembly Required)

HOW TO

Steampunk on a Thrift-Store Budget: A Guide to Successful Thrifting



HOW TO

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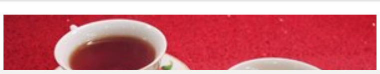
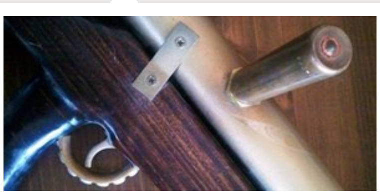
MOVEMBER MUSTACHING TIPS

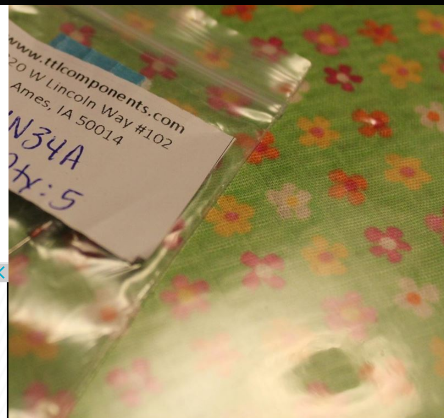
How to Grow, Curl, and Care for a Handlebar



HOT LATEST



STEAMPUNK SPRAY PAINTING



e diodes are type 1N34A, which suffice just fine for a crystal radio.

eally close in the above picture, that modern diodes are essentially just fixed-whiskers. That is, it's a cat's 't move.

ction, but not the other, but that probably doesn't mean

ur signal is flowing both forwards and backwards, you're
selves out, and do all kinds of things, making it unlistenable.
way, you only receive one version of the signal at your

ool. The water is everywhere in the pool at once, just like the
, and if you had a way to measure the waves at the edge of
ne if you threw two stones in the water at the same time, at
will meet in the middle and cancel themselves out, making the whole pool kind of wavy, but destroying the
te of a circuit is like the two-stone model, but adding a diode turns it into a one-stone model, allowing a pure

ce you've collected it from the antenna and then filtered it with a diode.

ou need a special type of earphone; the ones you have sitting around your house just won't do. That's because
se power, far more power than you can pick up with a reasonably-sized antenna.

coming down your line, you're going to need an extremely sensitive earphone that will react to the tiny
d a "high impedance" earphone, or a "ceramic" earphone.

mpedance earphone is still being made in the entire world, and it's terribly ugly. There are a variety of places
ne research and discovered that they all come from the same factory in the UK. Even more unfortunately,
awful, because some just flatly won't work and other die in short order. And what's more, the manufacturer
about it. Nice, right? However, if you want to buy a new high impedance earphone, you're stuck because

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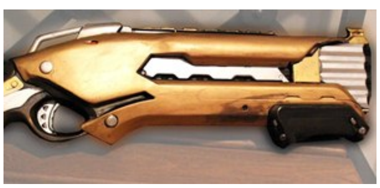

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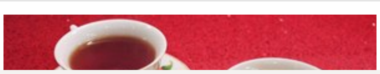
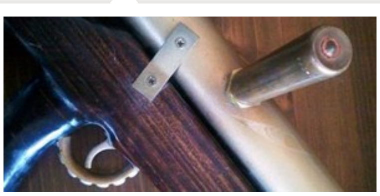


HOT LATEST



STEAMPUNK SPRAY PAINTING

nt to cut that off and expose the two wires at the end. It's
We'll get into that a little more specifically below.

uit. Without getting into technical things like current and
ached to the circuit doesn't get overwhelmed. With a basic
you may pick up enough power to blow your diode, which

the one that I used:

her complicated to explain without getting really technical. To be as simple as I can get, this resistor provides
uit. Resistance helps control the current of the electricity. This is the shallow end of a very, very deep pool, so

ct is that if you're going to have a long antenna, you should include a 47k resistor. They're available for sale
tore, and you can even order them on Amazon or Ebay.

parts are, it's time to start making a radio!

il. Coils are exceptionally easy to make. All you have to do is get something that's non-conductive (plastic,
e wire around it. You want to leave the insulation on, which in the case of regular wire will be plastic, but in
el. It will also work better the tighter the coil is, but it will still work with a loose coil.

...ing that's between 4-6 inches in diameter, and hollow. The less material there is between the wires, the ...r the magnetic field they generate will be. The form doesn't even need to be round... A square or rectangle one will work just fine. In fact, ... first crystal radio, I used an empty cardboard box.

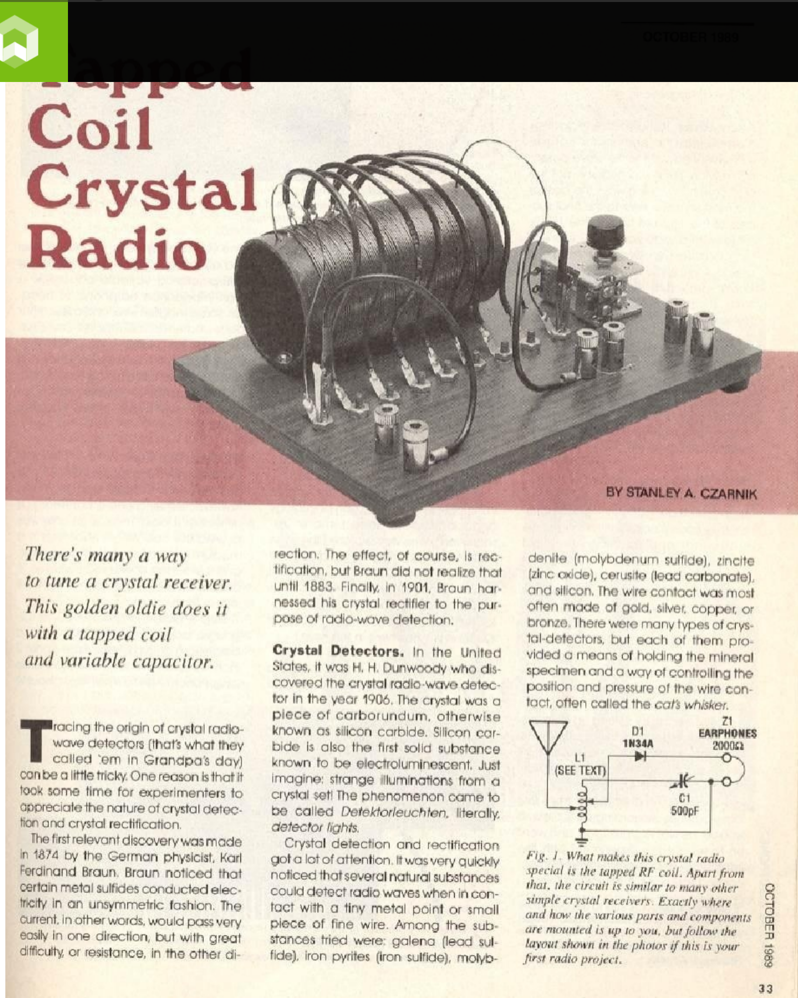
Bask in the glory of how ugly that radio is. But you know what? It worked. I could pick up signals, and it was just fine.

Now, I used a few things that you don't really need for a bare-bones set. First, I had a spare piece of wood lying around that I used as a base. You don't really need that. Second, I had some little metal clips that I used for ease of assembly, but you don't need those, either. Lastly, I had a little alligator clip, but that's not necessary either. The alligator clip may make life a little easier for you, though.

Anyway, what you want to do is wrap your wire around your coil form. Every three turns, make what they call a "tap". Taps are those little loops of wire you see in the picture above. You just take some extra slack and turn your wire into a loop. Do that once every three turns, and do a total of about 40 turns. That means you should end up with 13 taps.

The reason we're doing this is that our coil is effectively a homemade variable resistor. Variable resistors are also known as potentiometers, and they're the device you use in all sorts of things like volume knobs, dimmer switches, and the like. In this case, we're going to use that variable resistor to tune our radio by artificially lengthening and shortening our magnetic field. So, make sure you remove the insulation from your taps. If you have plastic insulation, you'll need a knife to do this, but if you have magnet wire, some sandpaper will work just fine.

Don't forget to leave some slack at the beginning and the end, because you'll need to connect those ends to other things.



Tapped Coil Crystal Radio

BY STANLEY A. CZARNIK

There's many a way to tune a crystal receiver. This golden oldie does it with a tapped coil and variable capacitor.

Tracing the origin of crystal radio-wave detectors (that's what they called 'em in Grandpa's day) can be a little tricky. One reason is that it took some time for experimenters to appreciate the nature of crystal detection and crystal rectification.

The first relevant discovery was made in 1874 by the German physicist, Karl Ferdinand Braun. Braun noticed that certain metal sulfides conducted electricity in an unsymmetric fashion. The current, in other words, would pass very easily in one direction, but with great difficulty, or resistance, in the other direction. The effect, of course, is rectification, but Braun did not realize that until 1883. Finally, in 1901, Braun harnessed his crystal rectifier to the purpose of radio-wave detection.

Crystal Detectors. In the United States, it was H. H. Dunwoody who discovered the crystal radio-wave detector in the year 1906. The crystal was a piece of carborundum, otherwise known as silicon carbide. Silicon carbide is also the first solid substance known to be electroluminescent. Just imagine: strange illuminations from a crystal set! The phenomenon came to be called *Detektorleuchten*, literally, *detector lights*.

Crystal detection and rectification got a lot of attention. It was very quickly noticed that several natural substances could detect radio waves when in contact with a tiny metal point or small piece of fine wire. Among the substances tried were: galena (lead sulfide), iron pyrites (iron sulfide), molybdenite (molybdenum sulfide), zincite (zinc oxide), cerusite (lead carbonate), and silicon. The wire contact was most often made of gold, silver, copper, or bronze. There were many types of crystal-detectors, but each of them provided a means of holding the mineral specimen and a way of controlling the position and pressure of the wire contact, often called the *cat's whisker*.

D1 1N34A
Z1 EARPHONES 2000Ω
L1 (SEE TEXT)
C1 500pF

Fig. 1. What makes this crystal radio special is the tapped RF coil. Apart from that, the circuit is similar to many other simple crystal receivers. Exactly where and how the various parts and components are mounted is up to you, but follow the layout shown in the photos if this is your first radio project.

OCTOBER 1989

33

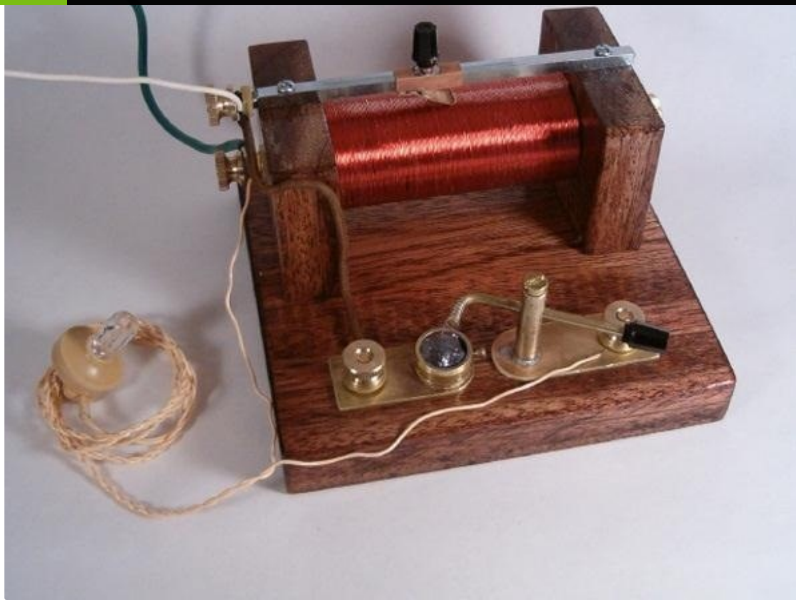
Now that you have a coil with some taps, the rest of the radio is just a matter of connecting your coil to your other parts.

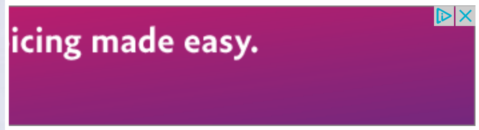
The top of your coil connects to your antenna. Just a simple copper-to-copper connection will suffice for all of these, too... No need to solder if you don't want to. You can simply twist the ends together and tape them, if you don't know how to solder. Just make sure that there's a solid connection, because if any of your wires are loose or don't fully touch each other, you won't get a signal.

So, like I said, the top of your coil connects to your antenna, and the bottom connects to your ground. Having a ground is very important for getting a good signal, though I understand that a good ground may be difficult for people who live in apartments, or in the city.

A ground is exactly what it sounds like: ground. Ideally, what you do is pound a metal rod a few feet into the dirt, and then connect the bottom of your coil to it. Barring that, you can connect your ground wire to some copper water pipes, or any other metal pipes that run into the ground. In other words, you want a way for your circuit to dissipate excess electricity.

Strictly speaking, a ground isn't necessary. Neither is an antenna. Your coil can function as an antenna in its own right, though without an extra antenna and a ground, be prepared to have an extremely faint signal. My current set is portable, so it has a small antenna and no ground, but I've taken some steps to make it a little louder. I'll go over those steps in the next installment of this series, but for now, either stick with an antenna and ground, or forgo them entirely for a weak signal.





From the end of the coil that you're connecting to your ground, you want to run a wire to your earpiece. Or, to half of your earpiece. Connecting an extra wire is easy, just scrape off some of the insulation and wrap one wire around the other. That wire will connect directly to one of the two leads on your earpiece.

This forms the outgoing wire, so that your signal can travel through your earpiece out into the ground.

Next, you're going to connect your diode to the other lead on your earpiece. You can either connect it directly, or via a length of wire. Whatever you prefer.

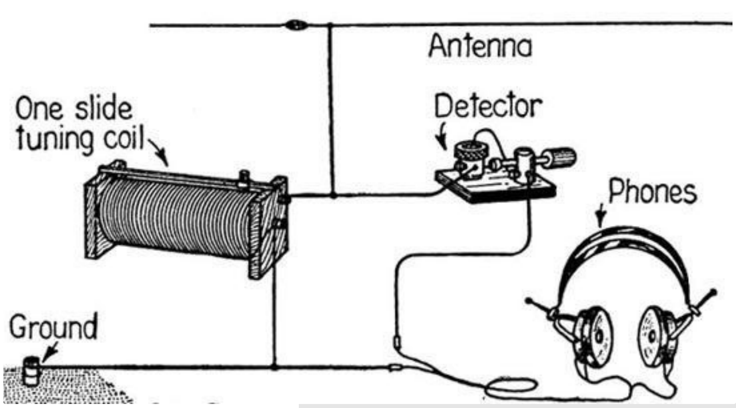
Lastly, connect the other end of your diode to a length of wire. If you have an alligator clip, attach that to the far end of the wire that's attached to your diode. Otherwise, no worries... Just make sure you remove the insulation from the end of that wire.

That's all there is to it! Now all you do is attach the diode-wire to the various taps on your coil until you hear something.

If you have a good-sized antenna, remember to add your resistor. The resistor will be connected to both leads of your earpiece.

Wasn't that easy? Once you've made the coil, there are really only six connections you have to worry about, and I'll list them here for you:

1. Top of coil to antenna
2. Bottom of coil to ground
3. Ground wire to earpiece
4. Earpiece to diode
5. Diode to Coil taps (via wire)
6. Resistor to earpieces



And now you have a working radio! Attach your diode-wire to the various taps until you find a station!

Troubleshooting

Okay, so, maybe your radio isn't working right off. Crystal radios are such incredibly simple things that there are only a few limited things that could be wrong. I'll try to cover them here.

1. Turn your diode around. Your diode may be pointing the wrong direction.
2. It's possible that your earpiece is crap, and doesn't work. Put the earpiece in your ear, and hold the two leads with one in each hand. Brush the leads against each other. If you hear a "click" when the leads touch, your earpiece is working. If you don't hear a faint click, your earpiece is broken. Sorry!
3. Check to make sure that all of your connections are solid, and that you've removed the insulation at any place where two wires are supposed to connect.
4. That's it. Really. A crystal radio is so simple that there are really only three possible things that could be wrong with it.

I hope you've enjoyed this crystal radio tutorial! There are a lot of other tutorials out there, but none of them really explained the theory and concepts behind the radio as much as I wanted them to, which is why I incorporated that stuff into my guide.

Radios can get a whole lot more complicated from here, but there are still ways to add functionality without having to dive off the deep end. In my next article in this series, I'll talk about antenna designs, variable capacitors, and more, so remember to keep checking Steampunk R&D!

Images not taken by me are from WikiMedia Commons, 1632, Makezine, University of Oregon, CrystalRadio.net, and Science Buddies

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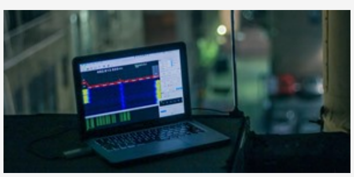
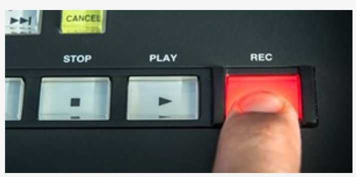


HOW TO HACK RADIO FREQUENCIES
Building a Radio Listening Station to Decode Digital Audio & Police Dispatches



HOW TO
Play & Record Thousands of Worldwide Radio Stations on Android

HOW TO
Build Your Own Internet Radio Player, AKA Pandora's Box

HOW TO
Build a Puzzle Box

7 Comments

CHRIS XTALMAN
3 YEARS AGO
1

I've built several of these radios over the years.

You can get some good steampunk headsets that are actually from the 1920's through the 1950's from Scott's headphones. I've had lots of dealings with him and he knows how to ship vintage phones without damaging them.

Most crystal radios have a faint signal from stations that are 20 or 30 miles away maximum. However, if you have the right parts, a good antenna and ground it is possible to hear stations 100 miles away and farther! Amazing when you consider that there is no power other than the tiny millivolts coming through the air.

This circuit is the one that is like the first radios people used when KDKA made the first commercial radio broadcast on November 2, 1920.

It's like the ones soldiers used in WWII in foxholes. They used a razor blade and a pencil lead instead of a diode or crystal as a detector. The razor blades work well, but not quite as good as the 1N34 diode in this circuit.

dd a variable capacitor in parallel with the coil, taps are not necessary. Also, you will increase your chances of getting distant stations. If you already have a radio like this, the taps help a little.

I suggest using American made 1000 to 3000 ohm headphones from the 1920's through the 1940's for distant stations. My Cannon Alnico phones are around 2000 ohms and I've heard 14 stations that are beyond 100 miles over the course of 3 years. Most of them 200 or 300 miles.

REPLY

ARUN RAGHAV
2 YEARS AGO

1

Wonderful steampunk device and thanks for sharing how to build it.

REPLY

CURT KACZOR
1 YEAR AGO

1

Question, my science class is going to make a radio.

I have magnetic wire and we are making a coil about 5-6 inches long. I have the diode that you suggested. However I've read that old telephone ear pieces will work for the headset. I haven't complete the project because I just received my diodes but do you think the telephone ear pieces will work?i hoping my class can assemble everything on Monday and have some success but I fear that the earpiece will let them down after reading your article. By the way, thanks for the examples of how this worked. It made it easy to explain to my class and they at least understand the very basic idea behind how this radio works.

REPLY

NAM DOYLE
1 YEAR AGO

1

what is the difference between using Variable resistors and Variable capacitor for tuning ?

REPLY

DAVID CRIPE
1 YEAR AGO

1

A coil and a capacitor are needed to make a resonant circuit that can tune a particular frequency. Using a variable capacitor or variable inductor or both are needed to tune different stations. Variable resistors are used for volume control, which for a crystal radio, is *usually* not a problem that needs solving.

REPLY

LEIF BURROW
1 YEAR AGO - EDITED 1 YEAR AGO

1

The simplest crystal sets, as the one described here didn't have capacitors. They still have a tuned circuit. There is capacitance between the windings of the coil, between the antenna and the earth, etc...

You can still see that kind of tuned circuit used today in multiband antennas such as are used for ham radios and external cellphone antennas. There is a coil in the middle of the antenna with the windings perfectly spaced. This acts a a filter so that higher frequencies see only the bottom section of the antenna but lower frequencies see the whole thing.

REPLY

LEIF BURROW
1 YEAR AGO - EDITED 1 YEAR AGO

1

That coil with it's taps makes a variable inductor not a variable resistor. A comprehensive explanation of exactly what an inductor is would probably be beyond the scope of the article but it's really nothing like a resistor. You might say that it's function is to store energy in the form of magnetism.

REPLY

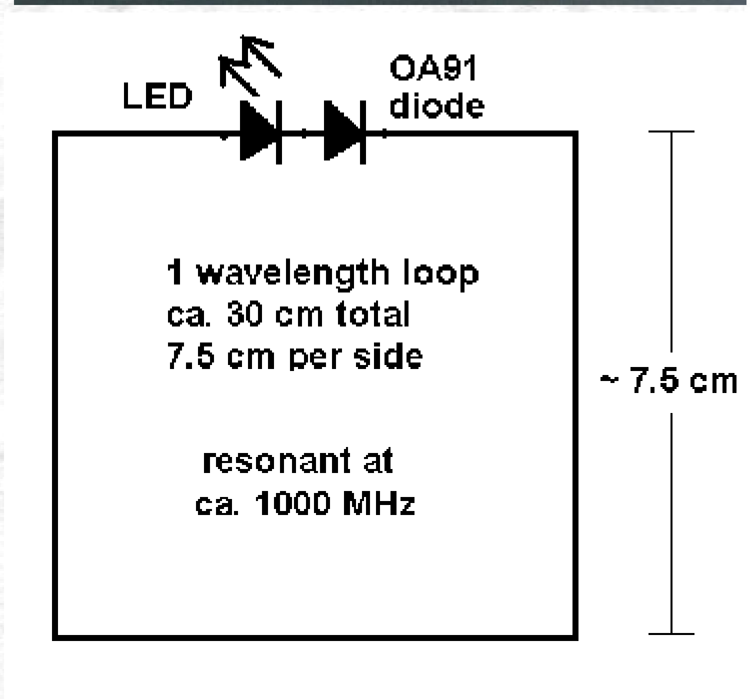
Share Your Thoughts

YOU
LOGIN TO COMMENT

Simple demonstration to show mobile phones emit radio waves

Dr Jonathan Hare, Sussex University, Department of Physics, Falmer, Brighton. BN1 9QH
Note: this article is in press: Elektor Magazine, July-August 2010, p. 56-57

For other experiments with this device please see my full article at: mobile phone detector



left: mobile phone radio wave detector and right: the simple schematic. Below: detail of the LED and germanium diode.

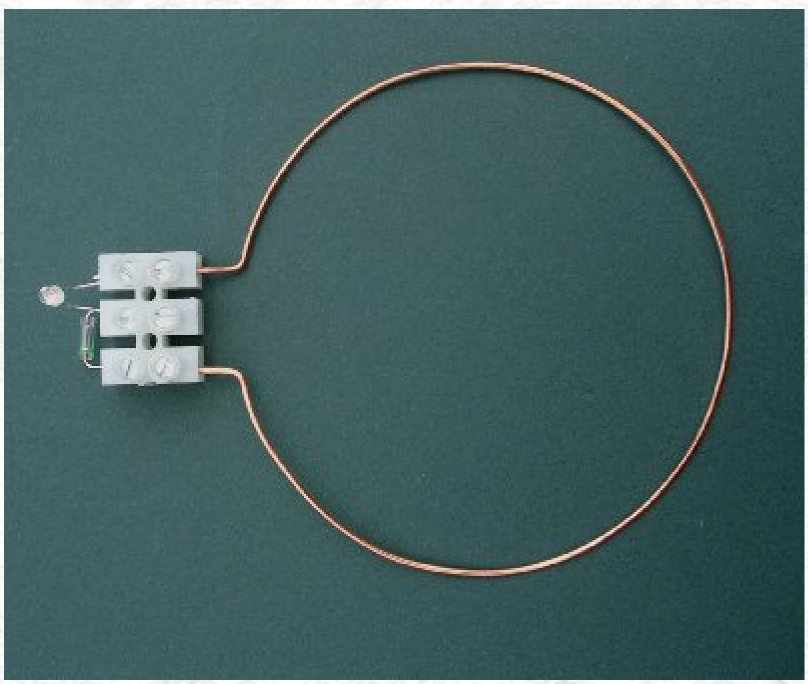
IMPORTANT NOTE: this device works very well on the old style mobile phones (as shown in the photo above). However, it does not always work well with modern smart phones. This may be because modern phones use higher frequencies, less power and use the power in a slightly different way (e.g. spread

spectrum). Some smart phones do work and success may be due to the signal strength of the local mobile phone mast nearby. If you are in a low signal area the phone will create more power to ensure reliable communications. If you are in a very strong signal area (very near the local network) your phone will drop its output power and consiquently there will be less power to pick-up and to convert to a voltage to light the LED.

This is a very simple and cheap device that demonstrates mobile phones ('cell phones' or 'handies') generate radio waves. We have a 30 cm (7.5 cm per side) full-wavelength loop antenna (a 'Quad' to radio amateurs) connected to a germanium diode and a hyper-bright LED. The loop can be made of copper wire, thin sheet metal or a track on a pcb. The diodes need to be wired correctly. I think the germanium diode is needed as the LED probably has too great a self-capacitance to perform at the very high AC frequencies generated by the phone (ca. 900 or 1800 Hz) but will work well with the DC pulses from the germanium diode (which has a very small capacitance).

To show the mobile generates radio waves put the mobile near to the loop and dial a number (use a free phone number, e.g. your voice mail) or text. The radio waves will induce a voltage into the loop, large enough to light the LED. The LED will flash indicating the digital data being sent by the mobile phone transmitter. You may need to set your phone to 'GSM 900/1800' rather than the '3G' network in the settings menu.

parts:
germanium diode: Maplin Electronics: QH71N or Rapid Electronics: 47-3114
LED: Maplin Electronics: UF72P or Rapid Electronics: 55-0085



A very simple connector block version and a circular 1 wavelength loop

THE CREATIVE SCIENCE CENTRE

Dr Jonathan Hare, Brighton, East Sussex. BN1 9QJ.

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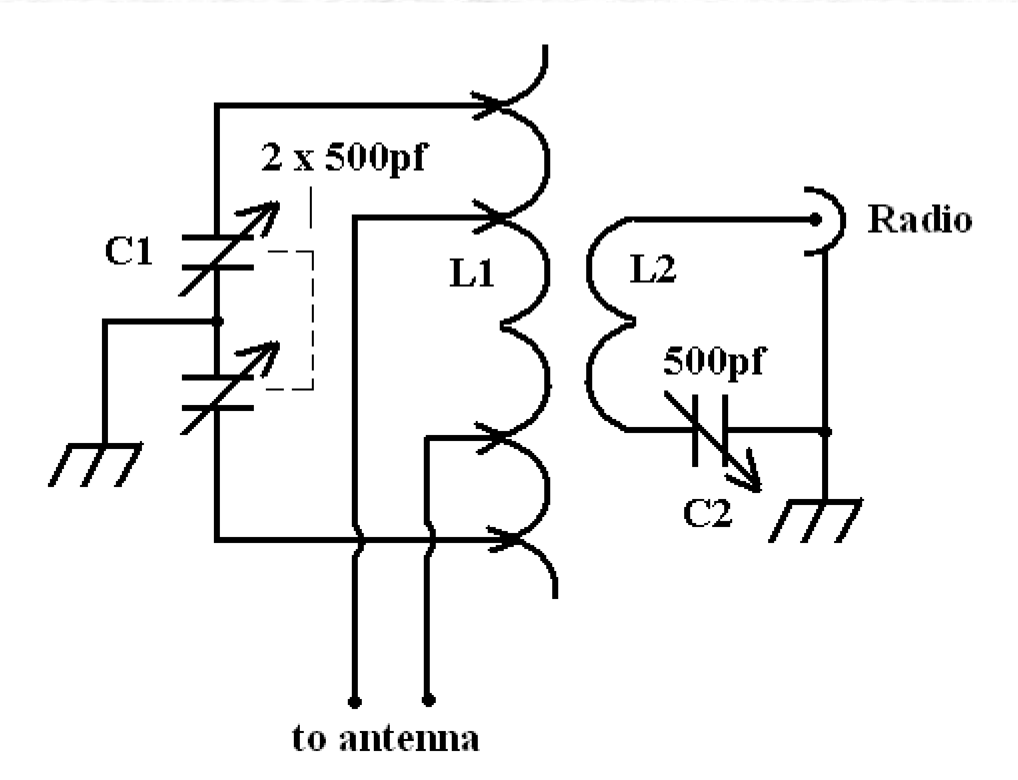
Balanced ATU



A balanced ATU
An ATU has the advantage of bringing the feeder-antenna system to resonance, act as a band pass filter (both on receive and transmit) and a low SWR. Further a balanced ATU means you can use open wire feeder. In general losses on open wire feeder are less than with coax. Below shows a schematic for a typical balanced ATU that will cover the 80m to 10m HF bands . The large coil L1 on the twin capacitor (C1) side can be 20-30 turns of 18SWG wire coiled 1 1/2" diameter while the coupling coil (L2) to the radio can be 3-5 turns ca. 2" diameter.

The second capacitor tunes out any reactance so that we can get a purely resistive load for the transmitter. Generally this is connected into the transmitter side of the coupling coil, rather than the earth side of the coil, but this means that an insulated shaft has to be used which is not so conveniant. I have found that wiring the capacitor on the earth side works well. I would be interested to hear from anyone who knows why this might be a problem.

I recently got this e-mail about the atu: and the position of the capacitor:

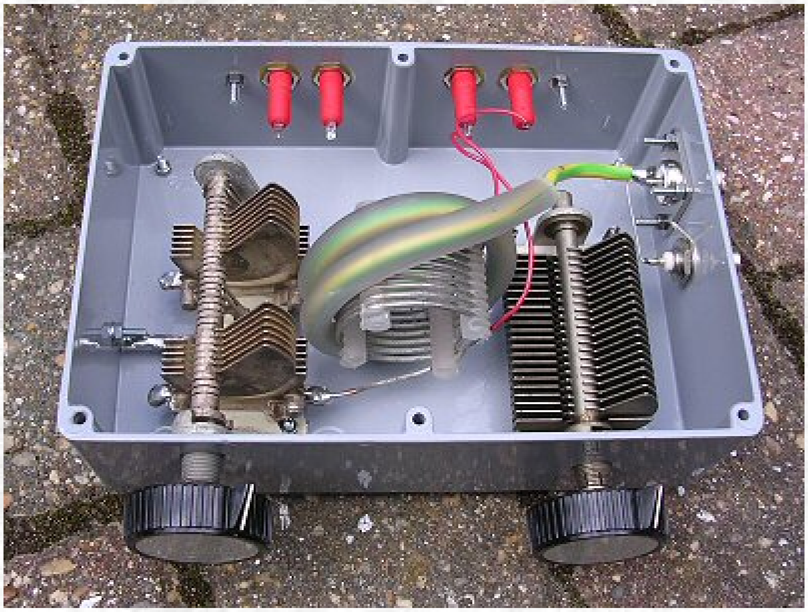
"To create a variable capacitor insulated from the ground (chassies) is a "piece of cake"! This task involves adding two or four ceramic pillars for the variable capacitor. The obvious advantage is that the tiny link coil is now grounded, and in addition, the radio equipment, TX/RX, is "DC insulated" from the Antenna Tuning Unit, a small price to pay for additional safety of the equipment. 73 from Bengt, SM6APQ"

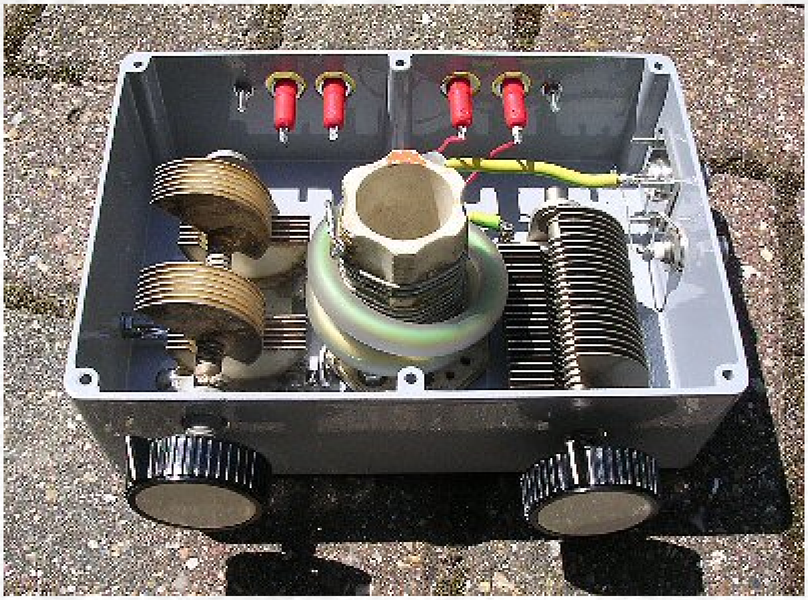
A smaller version for the 20 to 10m band is also shown below. I have used wire threaded into 1/4" plastic tubing for the coupling coil. When this is wound round the larger coil it provides spacing between the two sets of coils.

IN USE

Set the transmitter to low power while making all changes to the ATU while adjusting for lowest SWR. In use set C2 to half way and carefully tune C1 till there is a dip on the SWR meter. This will be quite sharp so if possible use a reduction drive on C1. Then adjust C2 and C1 alternatly to get the lowest (1:1) SWR.

Instead of using switches (which could introduce extra capacitance and loss) I used bananna (3mm) plugs and sockets for connecting the antenna and the capacitor. This gives a lot of fexibility for trying out various combinations of connections.





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Simple demonstration to explore the radio waves generated by a mobile phone.

Dr Jonathan Hare, Sussex University, Department of Physics, Falmer, Brighton. BN1 9QH
Note: this article has been published: Simple demonstration to explore the radio waves generated by a mobile phone J P Hare, 2010, Journal of Physics Education, Institute of Physics, 45, p. 481 45 481

Also see the brief full article at: mobile phone detector

IMPORTANT NOTE: this device works very well on the old style mobile phones (as shown in the photo above). However, it does not always work well with modern smart phones. This may be because modern phones use higher frequencies, less power and use the power in a slightly different way (e.g. spread spectrum). Some smart phones do work and success may be due to the signal strength of the local mobile phone mast nearby. If you are in a low signal area the phone will create more power to ensure reliable communications. If you are in a very strong signal area (very near the local network) your phone will drop its output power and consiquently there will be less power to pick-up and to convert to a voltage to light the LED.

Described is a simple low cost home-made device that converts the radio wave energy from a mobile phone signal into electricity to light an LED. No battery or complex circuitry is required. The device can form the basis of a range of interesting experiments on the physics and technology of our mobile phones.

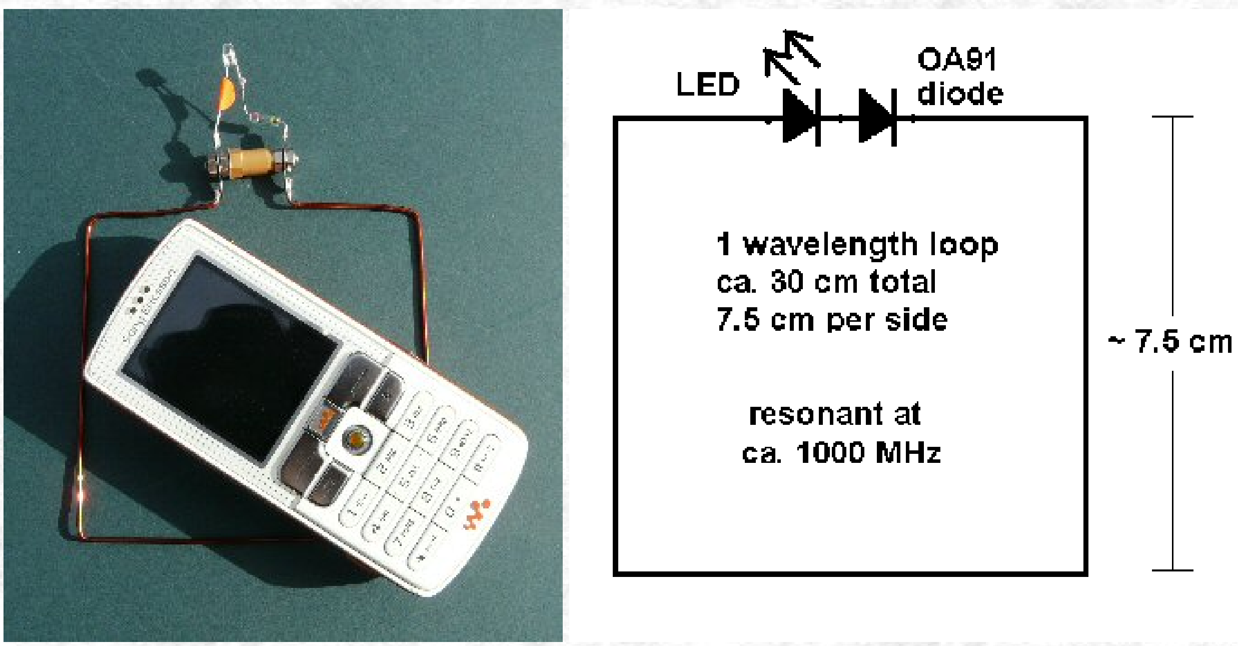


Fig. 1: left: mobile phone radio wave detector and right: the simple schematic

Introduction

Electromagnetic radiation (EMR) is at the heart of modern mobile phone data communications networks. The way a mobile phone and local base stations (the antenna covered masts you see dotted all around the place) communicate between each other is by using EMR in the radio wave part of the spectrum [1,2,3]. On switch-on your mobile sends digital information pulses by rapidly switching on and off the radio waves rather like a fast Morse code signal. Your text or voice is also converted into a series of digital pulses and sent across the network to be decoded (reassembled) by another mobile phone you dialled.

EM radiation and radio waves

Mobiles make use of various bands of radio frequencies to communicate between the mobile to base and the base to mobile: in Europe these include 900 and 1800 MHz (850 and 1900 MHz in the USA and Canada) [2, 3].

The relationship between wavelength, speed of light and the frequency follows the well known formula:
Wavelength λ (m) = speed / frequency = c (ms^{-1}) / ν (Hz)
λ (m) = 300,000,000 / ν (Hz) or approximately:
λ (m) = 300 / ν (MHz) ..... Equation 1.

So for a mid-range of about 1000 MHz (1 GHz) we get a typical mobile phone wavelength of about:
λ = 300/ 1000 = 0.3 m = 30 cm.

Simple radio wave detector

The loop consists of about a wavelength of wire, ca. 30 cm so each side is about 30/4 = 7.5 cm. The dimensions are not critical. The two ends are connected directly to a simple series circuit consisting of a high brightness LED and a germanium diode. They need to be connected correctly. All these components are cheap and readily available from electronic stores [4]. The loop can be made from a piece of copper wire roughly bent into a square (although a circular loop or rectangle will also work). If the wire is insulated remember to scrap off the insulation and solder-tin the ends. Simply solder the germanium diode and LED into circuit as shown in the diagram.

On a new LED the long lead is the positive (anode) while the short lead is the negative (cathode). The germanium diode has a line (band) around the end which is the cathode. When correctly wired the LED and the germanium diodes are connected so they both allow current to pass in the same direction, i.e. in the circuit diagram the arrows point in the same direction. In practice this means the LED and germanium diode are joined at the cathode of one and the anode of the other.

In my prototypes I used an insulator between the loop ends (light coloured cylinder in the photo) to make the whole thing more sturdy but this was purely for mechanical reasons and is not needed for the circuit to function properly. Note: a much more sensitive version using a x10 and x100 DC amplifier is described on my web site [6].

How it works and how to use it

When a radio wave passes across a metal object the EM fields cause the charged electrons in the metal to oscillate and this causes small AC currents at the same frequency to be induced into the metal. If a mobile is brought near to the loop and a call or text is made [5] the radio waves emitted from the phone pass across the loop. This induces a voltage into the antenna (the loop) and if it is close enough will be large enough to light the LED. As the loop is about one wavelength in size it is resonant and so there is a good transfer of power (low reactance) between the radio wave and LED.

The mobile phone automatically tests the network and adjusts its transmission power to maximise the battery life and minimise network interference. As a result the brightness of the LED will depend on the data being sent (the average signal), the local signal strength and how close the loop is to the phone. Why the second diode? - It's curious why the germanium diode is needed at all. The LED is a Light Emitting Diode after all and one would not think that another diode would help. However my initial experiments failed because I had not included it. The LED will have a relatively high capacitance which at these frequencies will tend to de-tune the loop and short out the LED. The germanium diode however is made up of a tiny wire which only makes a point-of-contact onto a piece of semiconducting germanium so it's 'self' capacitance is very low keeping the loop resonant.

The germanium diode will rectify the AC signal from the loop forming a series of DC pulses that will be nicely smoothed by the LED's capacitance. Without the diode however the raw AC signal from the loop will tend to be averaged to zero by the LED's capacitance.

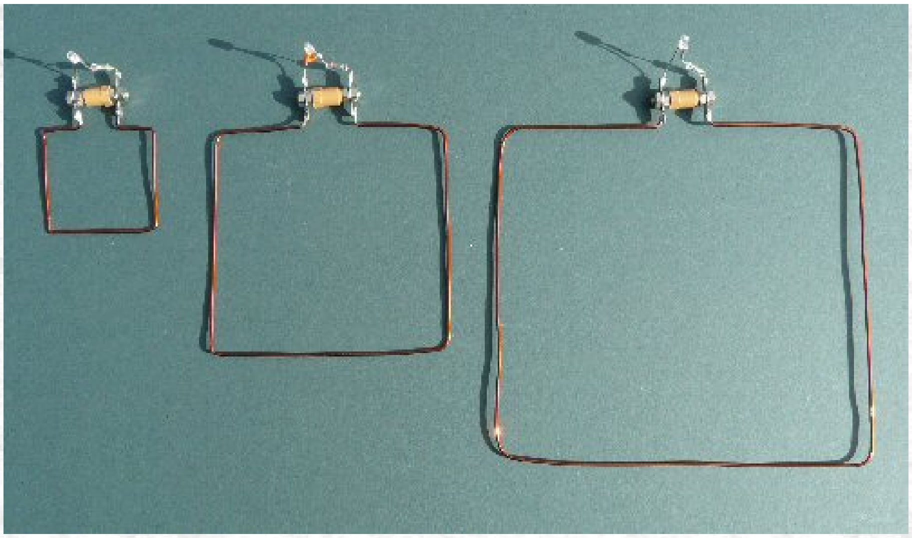


Fig. 2: Three loops in a row of varying size. The one described here and shown in Fig. 1 is shown in the middle. Smaller ones may well work better for higher frequencies such as the 3G networks (see below).

Other size loops
Fig. 2 shows a set of three loop devices with edge lengths of roughly 3.7, 7.5 and 15 cm. You can find out for yourself that the best match to the mobile signal is with the full wave loop of ca. 7.5cm per side. The other loops do work to varying degrees however (smaller ones may work better for the 3G network). The larger loop works well for the '70 cm' amateur radio bands.

Polarisation
The electric and magnetic fields making up the EM wave are orthogonal (they are at right angles to each other as they pass through space) to each other but depending how they are generated by the transmitting antenna can arrange themselves in any orientation with respect to the ground. If the electric field is parallel with the ground we say the wave is 'horizontally polarised' while if its normal to the ground we say its 'vertically polarised'. The loop antenna will respond best to one type of polarisation (depending on its orientation) so it's worth experimenting with the orientation of the mobile (or the loop) to get the strongest signal - brightest LED.

Mobile antenna
Inside your mobile phone is a transmitter / receiver and antenna. Many mobiles have this antenna at the top of the phone but some of the PDA type phones have it at the bottom. As a result you can locate the position of the antenna by moving it around the center of the loop till you get maximum LED brightness.

Networks
There are various different networks that a mobile may use both in the UK and abroad. It may be that you need to adjust the network phone settings on your mobile i.e. change from "automatic select" to set for "GSM" so as it get the strongest signal to light the LED. Note: the 3G network might not be powerful enough to light the LED. As the GMS network is currently the main network over the UK the device should work anywhere where you can get a signal as long as you check the correct selection on your mobile menus [5, 7]. The 3G network operates on a higher frequency (smaller wavelength) so you might find a smaller loop will work better than the main one described here. See 'other experiments' section below.

Test signals
In order to pick up the radio wave energy from the phone it obviously needs to be transmitting a signal. There are a few ways to do this:

1) On switch 'on' (or change of network) you can see that the mobile initially transmits for a few seconds to the network to tell it it's there (especially if you have moved since turning it off). You don't actually need to dial a number to detect these signals.
2) Even if don't text or call, throughout the day the mobile will send out data to 'keep up' with the network, especially if you are moving around (going through train tunnels etc. see below).

3) When you make a phone call you will transmit. Initially there is quite a lot of data being sent but in a few seconds data / power only gets transmitted when you speak. So to light the LED continuously you need to talk or provide some background sound continuously. Your service provider voicemail might be a good free phone number to try for these experiments [5].

4) Texting is the easiest way to show the radio wave power being transmitted. Long texts will light the LED for longer than short texts.

5) Finally set up the mobile on the loop and use another phone to text or phone the mobile. Even though you are not directly using the phone you will see that even on 'receive' the mobile phone transmits data to and fro. Ring off before you get charged.

Note: If you can use a free phone number it will save you money [5].

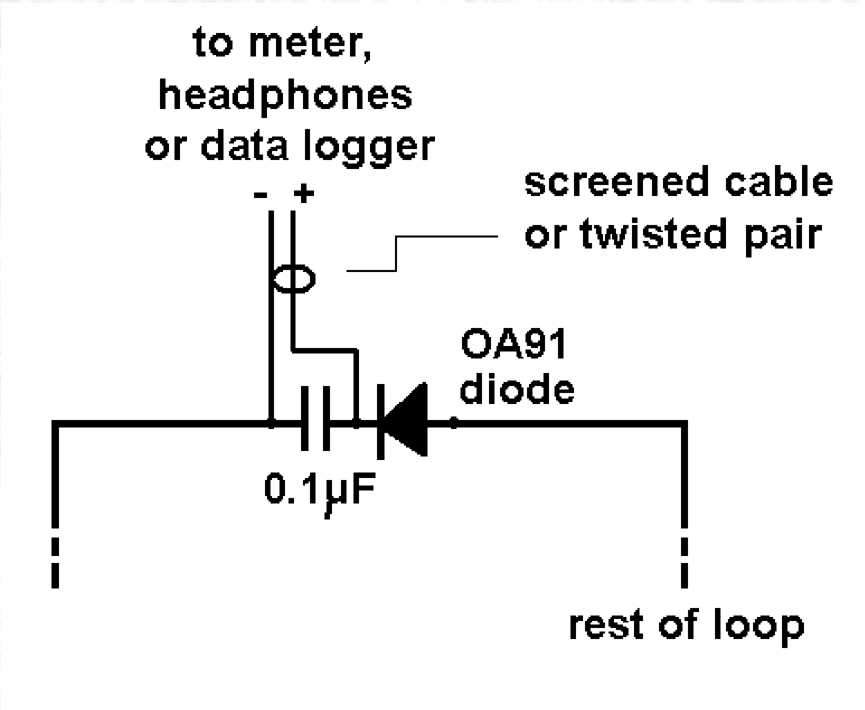


Fig. 3: Adding a capacitor and coax (or twin) lead so that headphones, a meter or a data logger can be connected (Note: diode is reverse wired compared to Fig. 1).

Other experiments:
Hearing data - if headphones are wired across the LED they will convert the voltages into sound and you can 'hear' the clicks of the digital data being transmitted. These are the same clicks that so easily get picked up by sensitive electronics such as a stereo amp or recording equipment when making a video for example. Hence - 'no phones on' when filming.

Logging data - if a meter, or better still a stand-alone data logger, is attached across the LED then one can monitor the EMR from the phone. For example even if you are not making a call your mobile will send signals too (and receive signals from) the network while travelling around. Fig. 3 shows a simple modification using a de-coupling capacitor so that a coax cable (or twisted pair) can be used to go to headphones, meter or data logger. Note the diode has been reversed so that the logger has the correct + and – connections for a unipolar input logger. The capacitor should help average the signal and stop radio frequencies going down to the logger. If one is available a few turns of the wire can be wound within a ferrite ring near to the logger so that maximum immunity to the mobile phone signal can be obtained for the logger electronics.

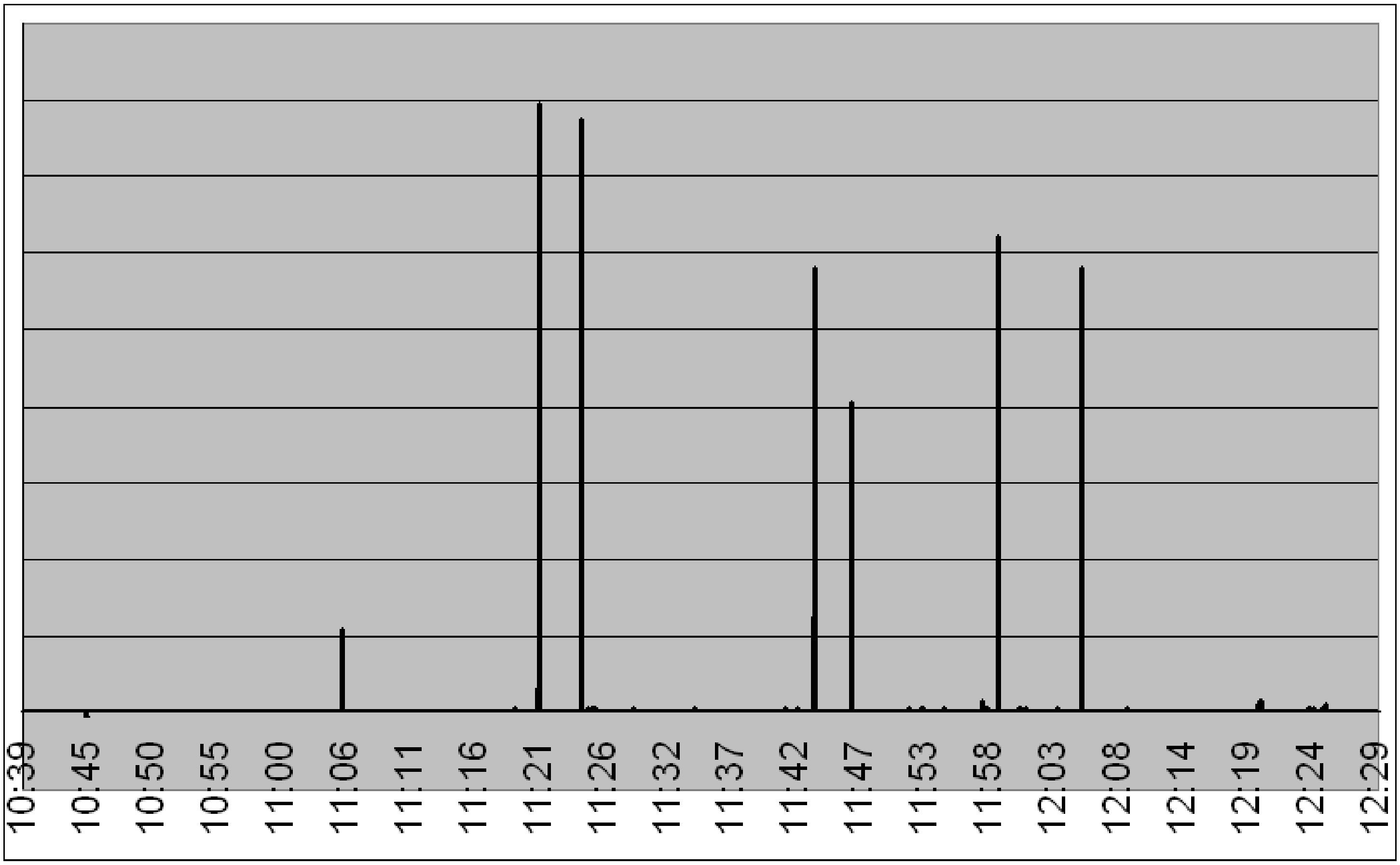


Fig. 4: Typical mobile phone data signals sent out onto the network while travelling around. These were recorded by a data logger from a mobile using the loop (no calls or text were made) while travelling on the train from Brighton to London Victoria (and then around London and return). Many of these peaks were the phone sending out 'I am here' data after coming out of one of the many long tunnels under the South Downs during the journey.

Out and about - Once you can log data you can discover all sorts of interesting things your mobile phone is doing without you realising it. Fig. 4 shows the plot over a few hours of travelling between Brighton and London (and within London) on the train. The detector was simply placed near to a phone that was not making or receiving a phone call or text, but was turned on.

The graph shows that the mobile sends out signals to tell the network where it is as it travels along and in particular goes in and out of long train tunnels. The peak heights vary because of the different powers the mobile transmits at depending on the signal strength of the local network and also because of the way the data logger 'snatches' a reading from the circuit every few seconds. As your phone sends out data onto the network to ensure the very best communications as you move around, so your mobile and the network obviously knows where you are and where you have been. Thieves and criminals beware the police can track you!

The inverse square law - If the transmitting mobile phone is moved away from the loop one would expect the signal to drop off. Unfortunately because both diodes need a certain threshold before they conduct the detector is not sensitive to small signals and not very linear. Therefore it's not very easy to use the device to measure the inverse square law (drop in signal v distance away) but of course you can see the signal go down. You could perhaps use the device to plot isobars - i.e. plot the equal intensity signals around the phone / nearby objects.

Changing the resonant frequency of the loop - you might be able to make some simple sliding mechanism (e.g. a small trombone-like mechanism) out of metal tube for example to tune the loop device for different frequencies. Then you can use it to find the average wavelength and so determine the center frequency by adjusting the size for maximum brightness of the LED. The wavelength can be determined by measuring the total distance around the loop. If we assume the antenna is one wavelength in total length then the frequency can be established by rearranging Equation 1, i.e. ν (MHz) = 30,000 / L (cm), where L is the length around the loop (cm).

Note: You will need to allow the transmitted digital signal to 'settle down' i.e. make measurements only after a few seconds after dialling / pick up so that only the sound data is being transmitted rather than the initial connection data. A constant sound will also need to be made so that the mobile phone continuously transmits data. It's worth playing music near to the phone or constantly whistling to keep sound coming into the phones microphone.

Mobile phone detector - teachers who want to know if the students / pupils really have turned-off their mobile phones (rather than just put on 'silent') can wire the loop device into the class room white-board speakers. Any mobile that is on in the class will send out signals which (if you are close enough) you will hear the data going to and fro - you will have your very own 'who's got their mobiles on' device which might be useful for exams etc.

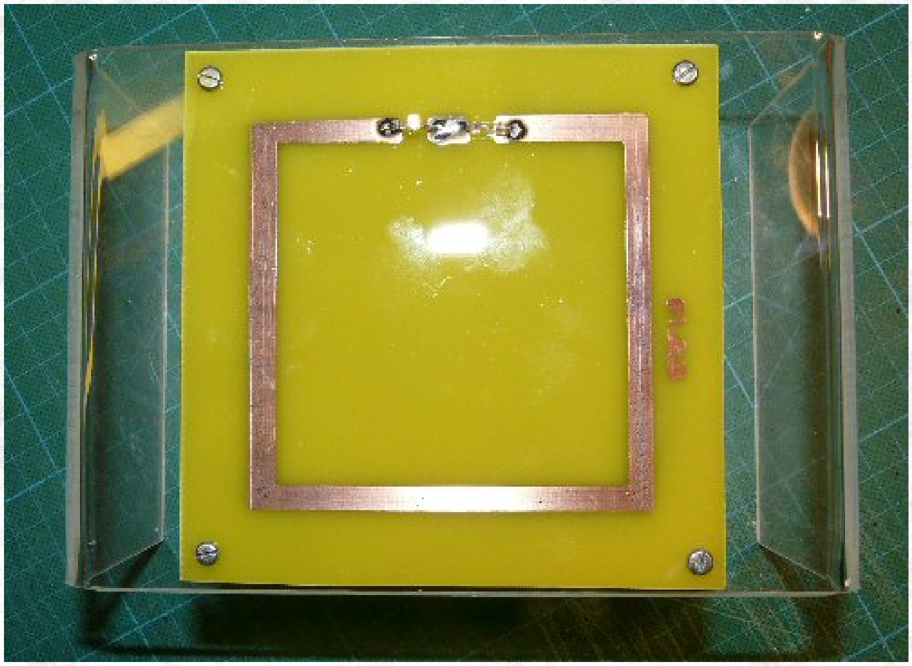
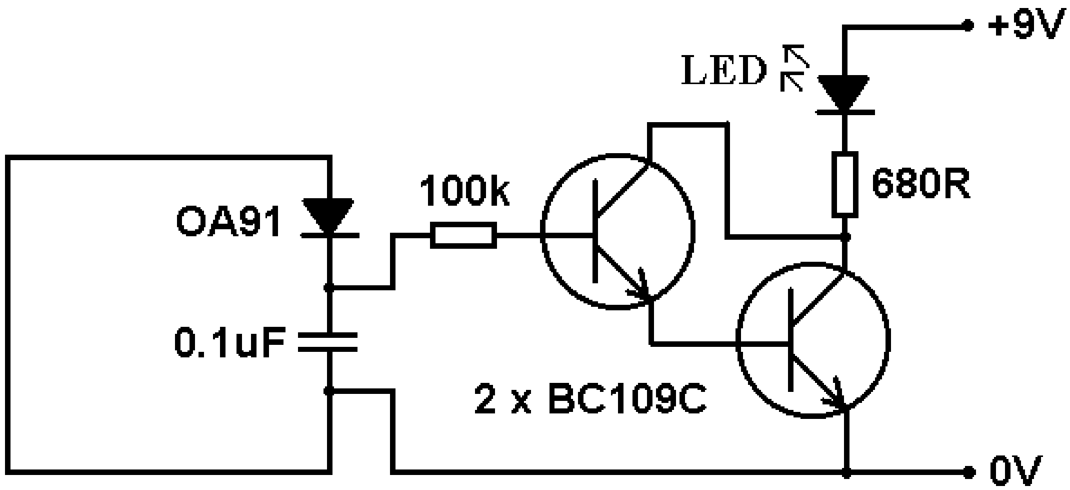


Fig. 5: The SEPNet 'deluxe' printed circuit board version (pcb) on a perspex stand where the loop is composed of a pcb copper track and the diode and LED soldered onto the board (top) [8,9].

Summary
All in all then, for such a simple easy to make device I hope you agree that there is a lot of scope for interesting science / technology investigations with your mobile phone. The device would make a good science week project (for radio amateur clubs etc.) A 'deluxe' pcb version (Fig. 5) on a perspex display case (Fig. 5) is currently going around the southern UK as part of the SEPnet outreach work, see the 'Radiation Exhibition' [8] and also as part of my on-going lecture series [9].

Post publication additions
(What follows was not included in the published article as this calculation was worked out later). A full wave loop is resonant and so looks purely resistive to the radio waves. Such a loop will have a resistance of about 100 ohms (Note: this is the AC resistance and not the DC resistance which will be very low). Now power $P = V \times I$ (V = voltage and I = current) and resistance = $R = V/I$ therefore $P = V^2 / R$ or rearranging $V = \sqrt{(P \times R)}$ which means that the voltage created by a power level of say 50mW (say for argument that roughly half the mobile phone power) arriving at the antenna will be about $V = \sqrt{(100 \times .05)}$ which is aprox. V = 2V, enough to light an LED.



This circuit uses a two transistor darlington driver to amplify the signal from the loop and diode making the detector much more sensitive. The LED will be much brighter using this circuit. Note: the circuit needs a battery to power it (e.g. a PP3 9V)

References

[1] These ultra high frequencies (UHF, > 1000 MHz) are also often called microwaves.
[2] wiki pages
[3] Elektor Electronics magazine, June 2005
[4] order codes for the germanium diode and LED are:
e.g. Germanium diode: Maplin Electronics: QH71N, Rapid Electronics: 47-3114
e.g. LED: Maplin Electronics: UF72P , Rapid Electronics: 55-0085
[5] to save money use your voice mail service (often you simply dial 121).
[6] for details of an amplified detector see: wavemeter
[7] select 'network setting' from the mobile phone 'settings' menu and then go to 'network mode' and select 'GSM 900/1800' rather than 'automatic'.
[8] SEPnet mobile phone device on display throughout southern UK. [9] for details of my talks see: talks and workshops

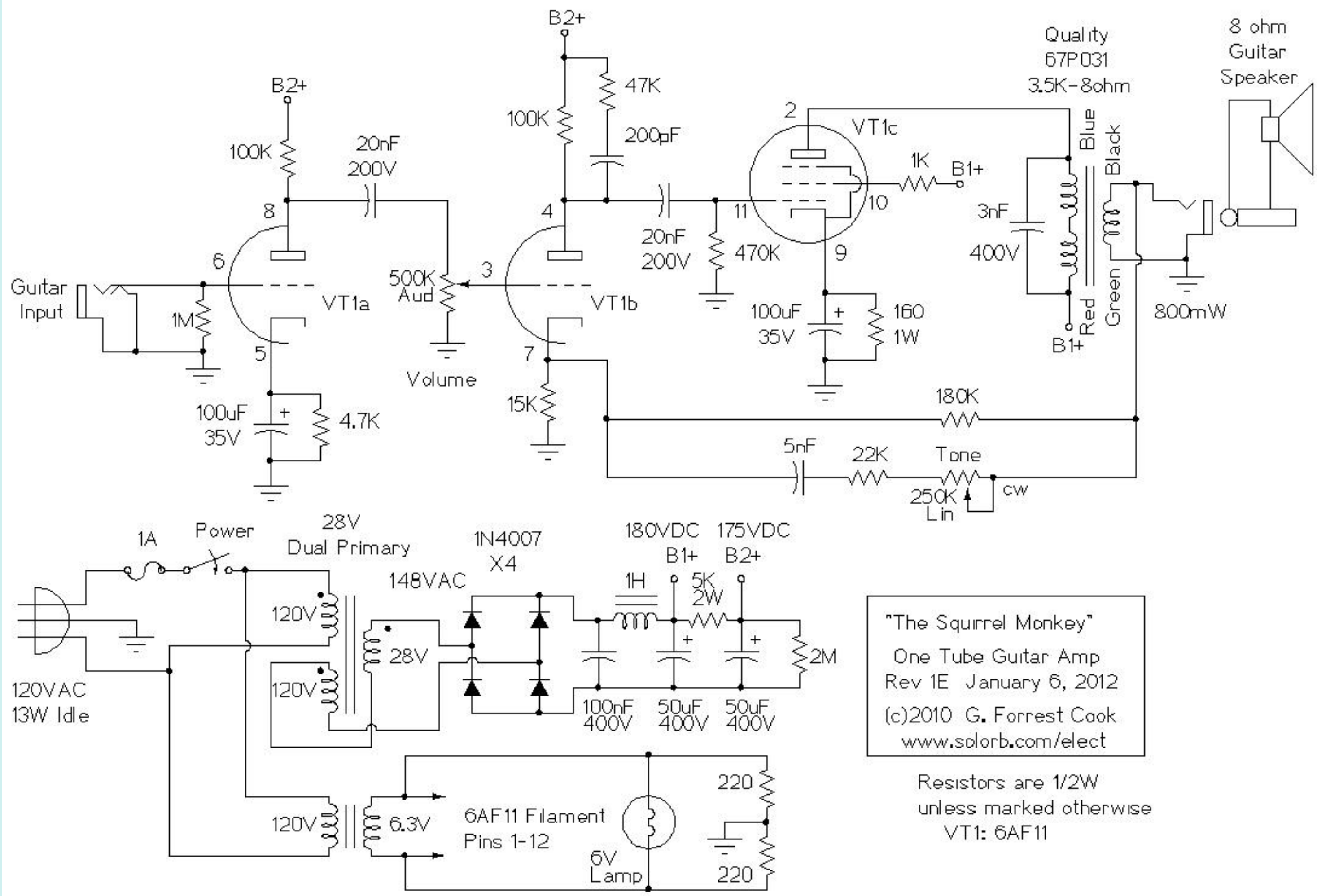
THE CREATIVE SCIENCE CENTRE

Dr Jonathan Hare, Brighton, East Sussex. BN1 9QJ.

The Squirrel Monkey One Tube Guitar Amp

The finished Squirrel Monkey amp and power supply boxes.

The Squirrel Monkey being prototyped, this mess actually worked.



Introduction

After building the full-featured Hammonator 2RVT and Lil' Tiger amps, then the simpler Spartacus amp, your author decided to go in a completely different direction and design a minimalistic class-A guitar practice amp. What makes the Squirrel Monkey amp interesting is the choice of a three-element 6AF11 Compactron tube which packs a high gain triode, a medium gain triode and a power pentode into one glass envelope.

The amp was originally going to be called "the Chimp" in reference to the Fender Champ, but that name has been used for several other amps, so the amp was named "the Squirrel Monkey" after the diminutive primate. The Squirrel Monkey amp is essentially a "Champ in a bottle".

The Squirrel Monkey is a simple design with only two controls, volume and tone (high cut). The amp only outputs 0.8W of audio power, but that is loud enough to work as a practice amp or a recording amp. The tone is surprisingly nice and the hiss is very low. The 120VAC input power was measured at 13 Watts. The Squirrel Monkey was constructed in two sections, the power supply and the amplifier circuitry. Each of the sections was built onto a pair of common 4"x4" electrical utility boxes.

Warning

This project uses high voltages including 120VAC and 200VDC. The project should only be taken on by someone who has experience working with high voltage circuitry. The power cord should always be removed when working on the amp, the circuitry is designed to discharge the capacitors when power is removed, but it's always a good idea to short out the electrolytic capacitors before working on the amp.

Connections

```
Power Input - grounded 120VAC
Guitar Input - High Impedance
Speaker Output - 8 ohms
```

Controls

```
On/Off
Volume
Tone
```

Theory

The guitar input jack feeds directly into class-A preamp VT1a, the single high gain triode section in the 6AF11. The preamp output feeds into the volume control pot, and that drives the power amp circuitry, VT1b and VT1c.

VT1b is the first gain stage in the power amp, it includes negative feedback input on the cathode and a high cut R-C network on the plate to lower RF sensitivity. VT1b feeds the output stage, pentode VT1c. Both VT1b and VT1c are running in class-A mode. The pentode is cathode biased to the tube's optimal 24mA by the 160 ohm

resistor. The 180K resistor from the transformer output to the VT1b cathode adds a small amount of negative feedback for stabilizing the amplifier. The 3nF capacitor across the output transformer keeps the output stage from oscillating in the RF region.

The tone control is somewhat non-standard, it involves an adjustable high pass network within the power amp's negative feedback loop. The negative feedback inverts this function to make an adjustable high cut filter. The tone control's response is quite useful, musically.

There are a lot of Fender 5E3 fans out there who think that negative feedback is a bad thing in any form. From my experiments, I have found that the secret of negative feedback is to use a minimal amount. That greatly reduces the production of bad-sounding distortion, while preserving the good-sounding distortion and punchy presence. Bad-sounding distortion is visible on an oscilloscope as square waves, spikes and radio frequency oscillations (snivets). Good-sounding distortion is visible as the soft rounding of the tops of the waves as a result of plate starvation.

A number of different junk box output transformers were tried in this circuit with minor variations in the performance. A 3.5K to 8 ohm transformer produced the most power output of the transformers that were tested. Since this is a relatively low power amplifier, it is not nececessary for the output transformer to be perfectly matched to the tube, although the volume will be loudest when the match is ideal. Transformers with input impedances from 2.5K to 10K should work and a common 5K to 8 ohm transformer would be a good choice if you cannot locate a 3.5K to 8 ohm unit.

The power supply section uses a standard 6.3VAC/2 Amp filament transformer for lighting the tube filaments up, the two 220 ohm resistors cancel out any filament-induced hum. If you use a filament transformer with a center-tapped output, ground the center tap and eliminate the 220 ohm resistors. If the filament voltage is much higher than 6.3V, it would be a good idea to trim the voltage with a small dropping resistor in series with the filament winding. This will extend the life of the 6AF11 tube. A value of 1/2 ohm at 1 watt should be about right.

The high voltage transformer uses a bit of trickery that has been seen elsewhere on Internet amplifier designs. A 28VAC/1 Amp (1/2 Amp would work) transformer with dual primaries is rewired so that one primary winding became a secondary winding and the 28V secondary voltage was added to the 120V secondary to produce 148VAC. This feeds into a bridge rectifier to produce the high voltage DC, which is around 210V with no load. A more common 24VAC dual primary transformer should also work fine here.

The high voltage DC is filtered through a capacitive/inductive pi filter to remove hum and produce the B1+ supply. The B1+ supply runs at around 180VDC with the tube plugged in. The B1+ supply is further filtered through an R/C filter to produce an isolated B2+ supply for the first two gain stages, this runs at around 175V. The 2M resistor discharges the capacitors when power is removed.

Parts

The project was built almost entirely with junk box parts that were scrounged from old radios and TVs. Most of the parts for this amplifier project can be purchased from mail order electronic suppliers such as Mouser, Digi-Key and Jameco. The 6AF11 tube and 12 pin duodecar Compactron socket can be found on eBay for reasonable prices.

The output transformer, power supply choke coil and high voltage capacitors are available from Antique Electronic Supply or other amplifier parts sources. Jameco.com part 101864/XFR2424Q should be suitable for the power transformer. Antique Electronic Supply sells the Hammond P-T154M 2H, 200mA choke and Hammond P-T1750F output transformer, which should both work for this project. Mouser.com is a good place to find diodes, resistors, jacks and potentiometers. See The Strat Monger for other parts suppliers.

Construction

The amplifier and power supply sections were built onto cover plates of standard 4"x4" electrical utility boxes. A chassis punch was used to cut out the 1-3/16" hold for the 6AF11 compactron socket. It would be a good idea to add more physical protection around the vacuum tube such as U-shaped rack handles or a top. Numerous other holes were drilled to mount the transformers and a few terminal strips. Most of the amp wiring was done between the tube socket and the terminal strips in a fairly high-density manner.

Three chassis knock-outs were removed on the front and back of the amp's utility box chassis. Pieces of double-sided circuit board were cut to fit into these spaces and holes were drilled into the circuit board pieces for the jacks and controls. Aluminum pieces would work just as well here. Standard Romex style cable clamps were used on the power supply box for securing the power input and output wires.

The two metal boxes were installed in an open-backed speaker cabinet with a 6" speaker. The power supply box was mounted on the bottom of the cabinet and the amplifier box was mounted under the top.

Beginners would be advised to use a roomier enclosure. An old 5-tube AM radio would make a spiffy box for this project. The speaker would probably need to be upgraded. A car stereo speaker would be a good choice since they are small and are designed to handle more power than a radio speaker.

Use

Plug the amp into a guitar speaker. Plug an electric guitar into the input. Tweak the knobs for a good sound. Play the guitar. Enjoy the warm tube sound. The simple design produces very little hiss. This is a fairly high gain amplifier and it can overdrive quite easily. If you want a clean sound, be sure to keep the volume control fairly low. Turn it up for more fuzz. If you liked the Squirrel Monkey amp, check out its successor, the Howler Monkey.

This amplifier also works well as piece of test equipment. It can be used to trace signals through amplifiers or other audio equipment. If you intend to use the amp this way, add a 50nF (0.05uF) capacitor in series with the input to prevent any external bias voltages from reaching the grid of VT1a.

Back to FC's Music Circuits page.

TIC TAC TOE

Page 1

Go to: P2 P3 P4

Player

Computer

Improved design by: Talking Electronics

Game Statistics

Win	Draw	Lose
0	0	0

Reset Scores

Who's first? ◉ **Player** ○ **Computer**

Start New Game

Data and files you will need:

PIC16F628 datasheet (pdf)
Instructions for PIC16F84A
Library of Routines
"Copy and Paste"
Multi Chip Programmer
IC-Prog MPASM
Notepad
BlankF84.asm
BlankF628.asm
Tic Tac Toe.asm
Tic Tac Toe.hex
Tic Tac Toe.lst

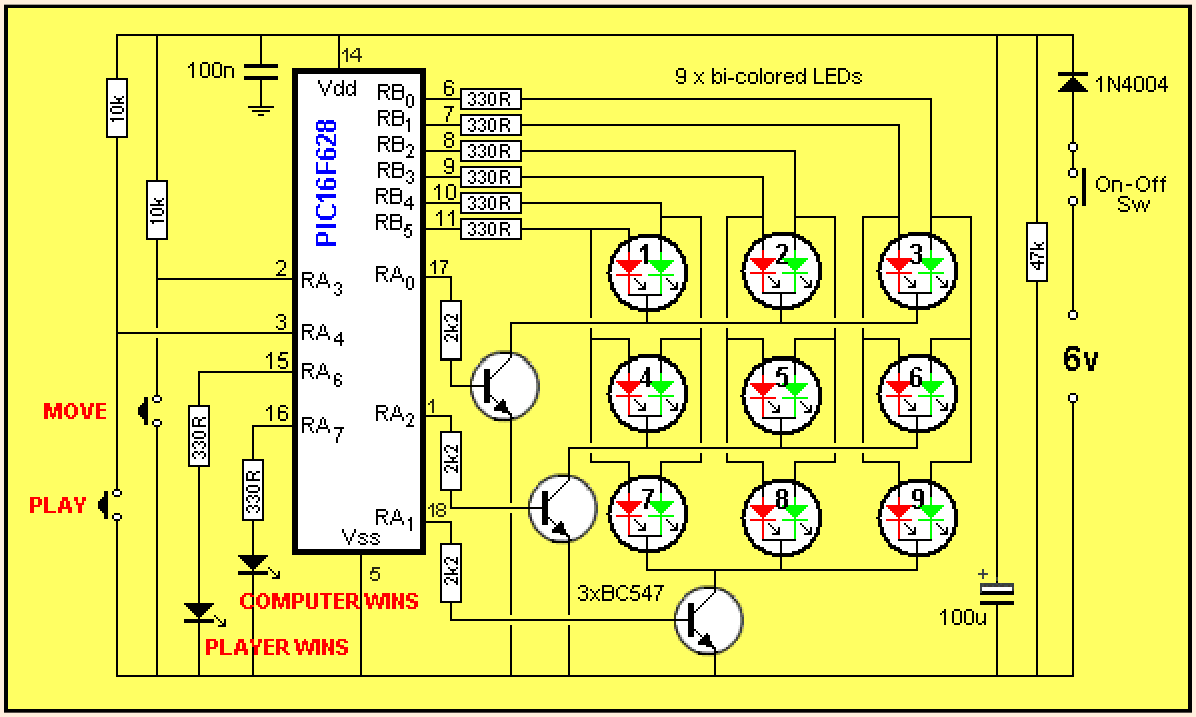
COMPLETE TIC TAC TOE

This project is not to introduce **Tic Tac Toe**. Everyone knows this game.
It's to introduce two features. Bi-coloured LEDs, microcontrollers and the skill of writing an ALGORITHM.
You can use the project to learn the skills of creating the **Tic Tac Toe** program or create animations on the 3x3 display.
Tic Tac Toe is one of the simplest yet most-challenging games to be invented. With just a choice of nine locations, two players can pit their wits and very quickly work out who is superior.
Even though the game is very simple, it has an enormous fascination. It is possible to produce a program capable of playing the game and have a high degree of "computer win."
Although the program we have produced does not use high-level strategy, it plays an interesting game.
The program has been kept as simple as possible to show how to produce routines that carry out a function.
One of the sub-routines, PWin, has been written in a linear-mode to show how long, but simple, it is. An almost identical sub-routine is CWin. It has been written using loops and this requires extra files to keep track of the "looping feature."
Many of the sub-routines are ALGORITHMS. This is a routine that solves a problem. The routine looks to see if a certain condition is present and produces an answer. This is the basis of "Computer Intelligence" or "Artificial Intelligence." (**AI**). When a number of these routines are combined and a result is obtained in a very short period of time, the computer appears to be "clever."
There is nothing more rewarding than producing a program that delivers "feedback" of this type. It's the programmers' high-light of the day.
The microcontroller we have chosen is a PIC16F628. (It's an upgrade of the PIC16F84A and with a couple of components added to the board, an 'F84 could be used.)
This is one of the latest low-cost micro's on the market and is an ideal starting-point for beginners to the "**art of programming**."
The micro is easy to use and has a re-programmable feature that allows it to be programmed almost any number of times.
A game or toy is an ideal place to start as you know how it is played or how it is used and it's just a matter of seeing how the routines are created - so you can copy them or use them in other programs.
There is one other advantage of using a game. It introduces strategy. If the game is played against the "computer" and the computer has a chance of winning, it appears to have "intelligence."
The program for this game can be developed in two different ways -as an ALGORITHM or in "linear-mode." An algorithm is essentially a routine consisting of instructions that come up with a definite answer. The program could consist of a single, extremely complex algorithmical sub-routine. It would take hours to explain the thinking behind the structure of the routine and beginners would be left, floundering. The solution is to produce a program with very simple sub-routines. And this is what we have done.
A linear-mode layout makes the micro run through the program and find a set of instructions that

applies to the particular condition. This type of layout requires more instructions but it is much easier to follow.
Many of the programs on the web (and in books), have been developed by very clever programmers and it may take an hour or more to work out what the program is doing!
This is not the approach we are taking. The routines we have produced are very simple and each instruction is fully explained.
Don't be dissuaded by the length of the program. It's really individual sub-routines that can understood if you sit down and "apply yourself."

ATTRACT MODE

When the project is turned on, the screen flashes and shows the effectiveness and capability of the bi-coloured LEDs. This is called the **ATTRACT MODE** and is sometimes used in amusement machines to attract players. The LEDs flash from red to orange to green and then a single LED in the centre of the display gradually changes from red to green. There are 256 steps in the change. To produce this gradual effect, takes about 20 instructions and the program shows how this is done.
The routines for the **ATTRACT MODE** are separate from the **Tic Tac Toe** game and the buttons are monitored during the Attract Mode to allow the player to go to the game. When either button is pressed, the micro goes to **Tic Tac Toe**.



TIC TAC TOE CIRCUIT

TIC TAC TOE PARTS LIST

au**$28.60** plus $3.50 post

Order kit

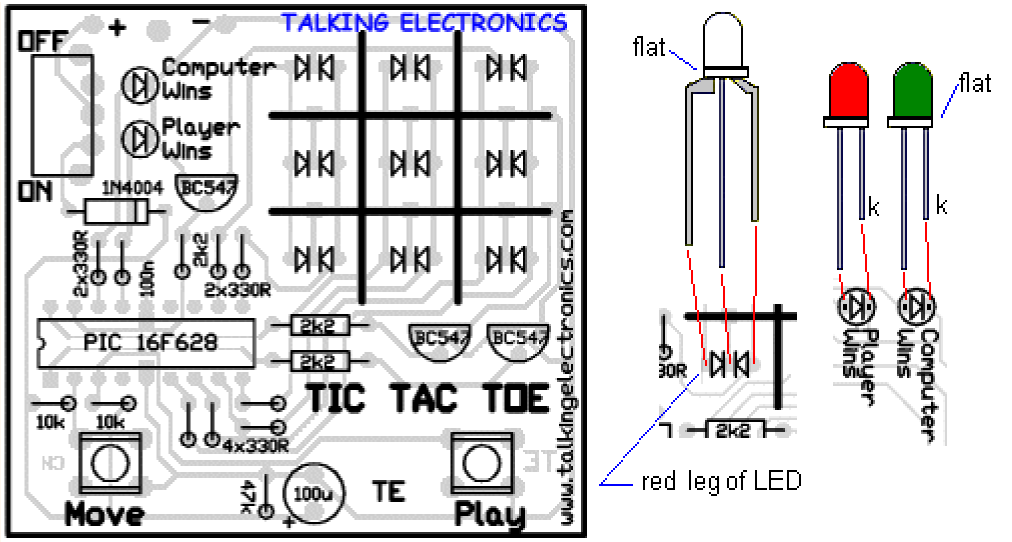
8 - 330R all 1/4 watt 5% resistors
3 - 2k2
2 - 10k
1 - 47k
1 - 100n surface-mount capacitor
1 - 100u 16vw electrolytic
1 - 1N 4004 power diode

3 - BC 547 transistors or similar
9 - 3mm bi-colored LEDs
1 - 3mm red LED
1 - 3mm green LED
2 - tactile switches
1 - 18pin IC socket
1 - PIC16F628 Tic Tac Toe microcontroller IC
1 - SPDT slide switch
50cm - very fine solder
5cm very fine tinned copper wire
1 - 3cm double-sided tape for battery box
1 - 4-AAA cell battery holder
4 - AAA cells
1 - TIC TAC TOE PC board

Kits for **Tic Tac Toe** can be obtained from Talking Electronics:
http://www.talkingelectronics.com

THE FIRST STEP

The first step is to work out how the micro will drive the display. Although the display consists of 9 LEDs, each LED contains two elements - a red and green emitter.
The output is orange when both emitting chips are driven and when either chip is driven, the output is red or green.
Other LEDs are also available with three chips inside to produce red, green and blue. When all chips are driven, the output is white light.
Bi-coloured LEDs have 3 leads. The two light-emitting parts of the LED have the cathodes connected together and this is taken to the 0v rail. In our project, we have connected the LED so that the lead to the red chip is on the left and the green is on the right.
This means the display is very similar to driving 18 separate LEDs.
This allows a scanning routine with a "run-of-three."
Since we do not have enough outputs on the micro to drive all the LEDs at the same time, we need to introduce a drive method called "multiplexing."
This involves turning on one row at a time and repeating the process at a rate that cannot be detected by the eye. The effect is to produce a display that can be fully illuminated with any LED producing any of the three colours.
As each row is turned on, six outputs from the micro take the six elements of the three LEDs to the positive rail, via current-limiting resistors.
Each line for the micro can only supply 25mA and if each LED is illuminated for 33% of the time, the average current will be about 8mA.
The brightness of a LED can be produced in two different ways. It can be constantly illuminated with a current or pulsed with a higher current for a short period of time.
In our case, the pulse of 25mA for a duty cycle of 33% is equivalent to a constant current of not 8mA but about 12mA and this is sufficient to give a very good output brightness.
Thus we will have no problem with the illumination of the display.
Once we have the scan routine worked out, we can decide on the best pins of the chip for each row of LEDs - mainly to simplify the track-work on the PC board.
We are now ready to wire a prototype and start producing routines to illuminate the LEDs.



The PCB Overlay and fitting the LEDs

HOW TO PLAY

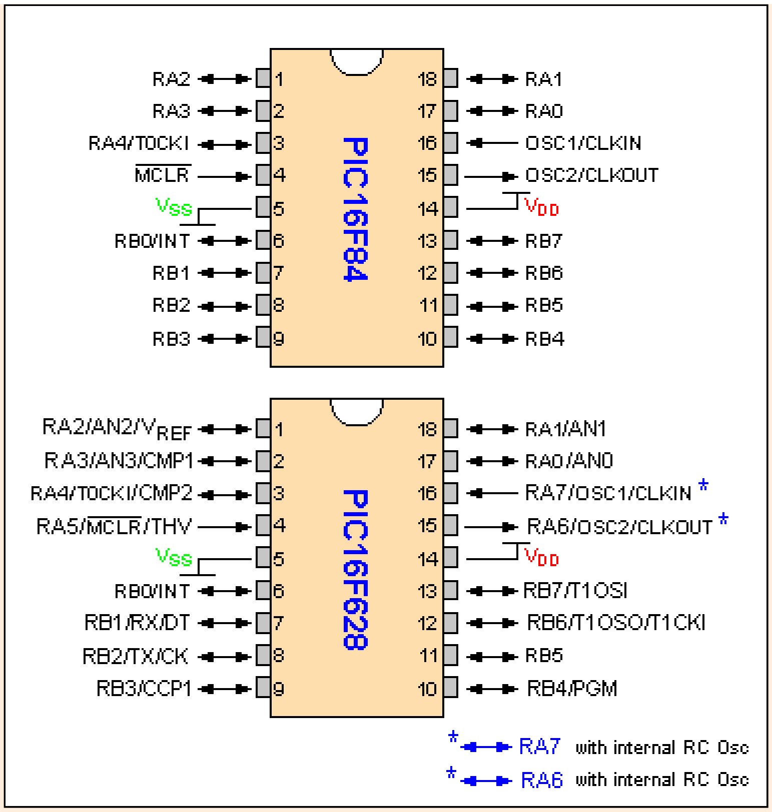
When the project is switched on, the ATTRACT MODE is displayed.
Push button "A" to cancel the effect and introduce an orange flashing cursor.
By pushing button A, the cursor will move across the display. Push button B to change the cursor into a red LED to indicate your move.
The computer will then make its move and show a green LED on the display.
Push button A again to bring the cursor onto the display. Push "A" again to increment the position for your next "X." The computer will then make its move.
Continue in the way to complete the game.
The "Player Wins" or "Computer Wins" LED will turn on to indicate a winner. If both LEDs turn on the game is a draw.

IMPROVING THE PROGRAM

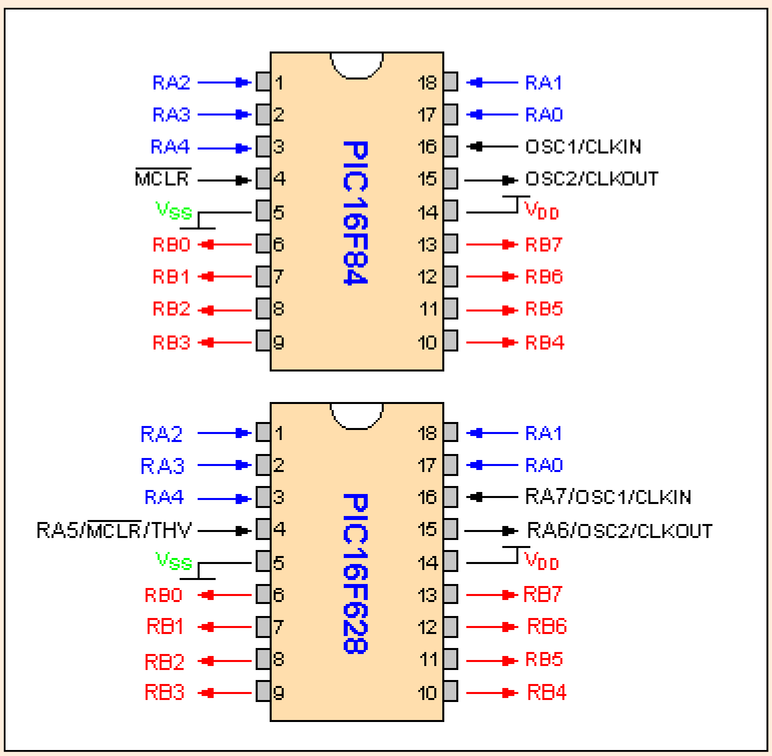
The program has plenty of room for improvement. It has not been optimized (kept short) nor has every strategy of the game been covered.
These are things you can investigate.
The whole object of this project is to teach the concepts of programming and games are one of the best ways to develop impressive sub-routines. Each sub-routine takes a number of possibilities and produces a result. The result may be a "nil result" and the micro goes to the net sub-routine. Even so, the generation of a "nil result" requires a functional sub-routine.
No only is the operation of each sub-routine important, but the order in which they are placed in the program is very important.

THE PIC16F628

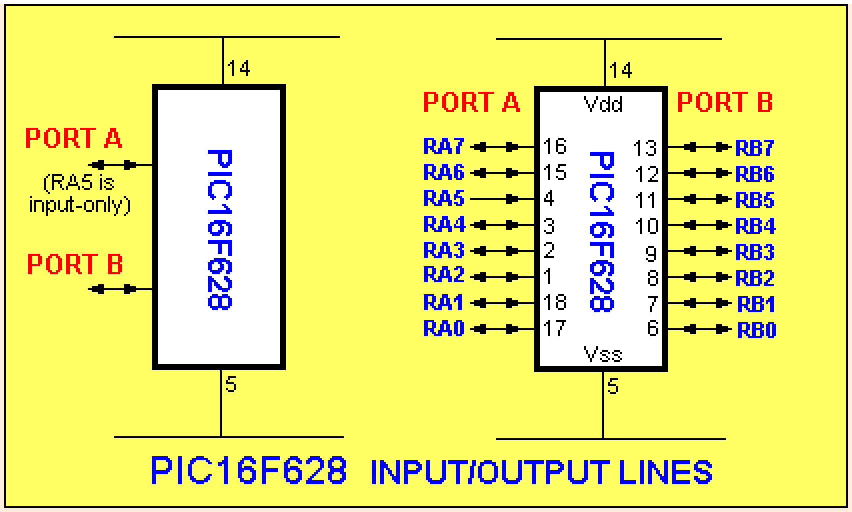
The PIC16F628 is an 18 pin chip with 16 in/out lines. Not all the lines are both input and output and the pinout below shows the lines with only one capability.



The diagram above shows the port lines for the PIC16F84A and PIC16F628.



The diagram above highlights only the port-lines that are common to both the PIC16F84A and PIC16F628.
Lines RA5, RA6 and RA7 on a PIC16F628 are not available on a PIC16F84A.



THE RULES

Everyone knows the rules of **Tic Tac Toe**, so we don't need to describe them here. But there is one point we should explain.
There are various levels of play to the game.
The simplest is to make a series of moves in the hope of achieving a win. The other is to "set up" the board to create a win in two directions.
In this ploy there are two approaches. One is an obvious "split" by taking opposite corners, the other is more sneaky.
It involves placing pieces on either side of your opponent and thereby creating a non-threatening situation. The next move will place a key piece to link-up the two directions and the game is won.
This can be called "levels of play" and the computer has been programmed to recognise the first two but not the third.

THE PROGRAM

A replica of the board is created in memory via Preload. It clears nine locations, from 31h to 39h. These correspond to the nine squares on the board.
The cursor uses one location before and after these so it can "hide."
The cursor starts in location 30h and moves across the board to location 3A. The program takes the cursor from location 3A and puts it in location 30h.
Each time "**Move**" button is pushed, the cursor moves across the display. This creates an orange flashing LED on the display.
When **PLAY** button is pressed, the flashing cursor is converted to red to represent the player piece and a number of sub-routines are executed to produce the best outcome for the computer.

The program consists of a Main routine that is constantly looping. It scans the display and illuminates the LEDs according to values in memory locations 31h to 39h. If a location has 01, a red LED on the display is illuminated. If the value is 04, a green LED is illuminated. If the file holds 05, both red and green are illuminated to produce ORANGE.
The cursor is "flashing orange" and to make it flash, the display is scanned a number of times (determined by the number of loops in file 22h) and then the cursor is "hidden." It is hidden by changing the value from 05 to 08. The display is looped a number of time and the cursor is placed back on the display.
The display is scanned by outputting a HIGH to LEDs on six lines of PortB. RB0, RB1, RB2, RB3, RB4 and RB5. These 6 LEDs represent the red and green elements of the top three bi-coloured LEDs. A single sinking transistor takes these LEDs to the 0v rail. The transistor is turned off and the information for the middle three bi-coloured LEDs is outputted on the 6 lines of PortB.
The middle transistor is then turned on and the elements are illuminated.
This is continued for the lower 3 LEDs.
By repeating the process very rapidly, the whole display is illuminated.

Go to: P2

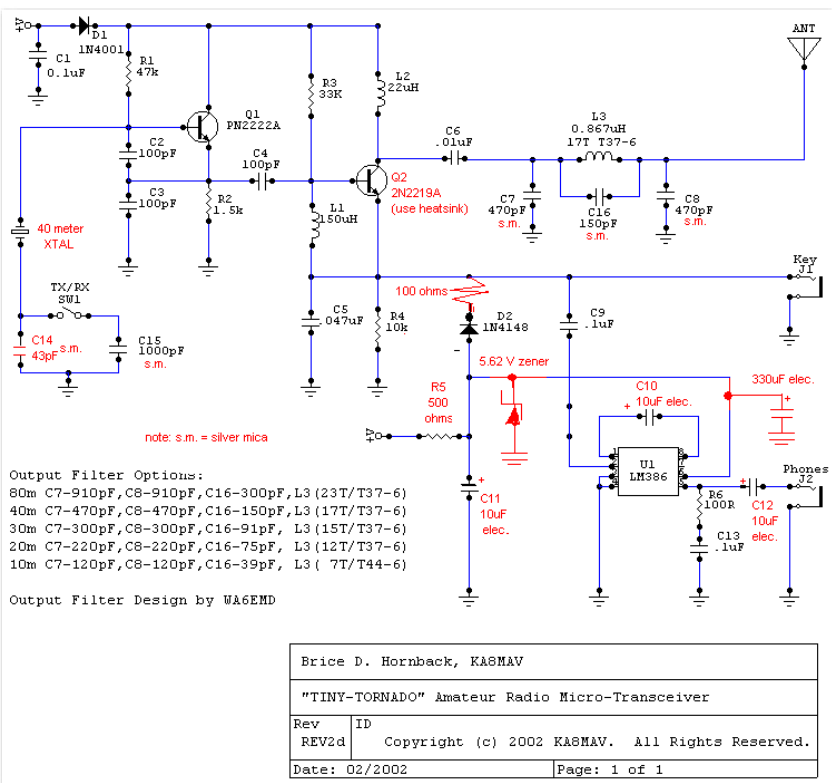
Tiny Tornado for 80m

Posted on 11 April 2015 by Ernest

Many years ago I built a prototype of the famous "Pixie 2", one of the simplest and smallest CW transceivers ever designed. The main issue is that the TX and RX frequency is the same, so the opposite station needs to shift which he probably doesn't know, so it takes quite some patience to get a successful QSO. Once published, lots of improved designs appeared in magazines and on the internet, one of them being the "Tiny Tornado". Since I had some mint tins left, I decided to build this little wonder.

The closed box.

The original Tiny Tornado is designed by Brice KA8MAV and published on the web by George KC6WDK. The most important part is of course the circuit diagram:



Circuit diagram of the Tiny Tornado, designed by Brice KA8MAV and published by George KC6WDK.

You can build this rig for any shortwave band by inserting the appropriate crystal and build the correct band filter. Component values for the band filters are listed in the diagram. For some unknown reason I always have some 3.579 MHz crystals in my junkbox, so I built the 80m version.

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search...

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- → 30m QRP transceiver: part 1, 2, 3, 4, 5, 6
- → HB9CV-in-a-box antenna for 23cm
- → Automatic antenna tuner using an Arduino
- → Squalo antenna for 6m
- → Pixie2 QRP transceiver for 80m

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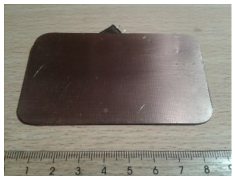
The most notable change (compared to the original Pixie-2) is switch SW1 with capacitor C15. By closing SW1 capacitor C15 is placed parallel to C14, resulting in a little shift of the Clapp crystal oscillator. This allows you to shift the frequency when starting transmitting.

Building was rather straight-forward. I started with a piece of copper clad, fitting on the bottom of the tin. I soldered another small sheet of copper clad on top of the bottom, to keep the battery away from the circuit.

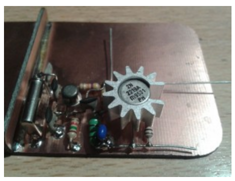

The battery compartment.

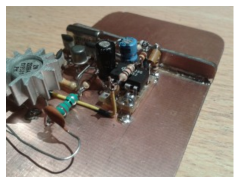

The base, made of copper clad.


So far, everything fits.

Then I placed all components, using my favourite "Manhattan style" building method.


The crystal oscillator.


Final stage, also demodulating circuit.


Audio stage.

I left some free space for the connectors and cut away these parts of the copper clad bottom. I drilled holes in the tin and mounted the connectors. After testing the circuit I placed it in the tin as well, and fixed it using double sided tape on the bottom and some soldering on the sides.


Leads attached to the connectors.


The completed circuit.

The closed box.

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November 2014 (2)
October 2014 (1)
September 2014 (1)
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June 2014 (3)
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August 2010 (2)
July 2010 (2)
February 2010 (1)
March 2009 (1)
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July 2006 (1)
December 2005 (1)
October 2002 (1)
August 2002 (1)

Important notice

This is my personal website, it reflects my personal opinion and has no relation to my job or whatsoever.
An appropriate amateur radio license is required to own and/or build and/or use the transmitters described on this website, depending on local regulations.

The rig, placed on top of my Junker key.

This article was also published in:

- DKARS Magazine, May 2015

Posted in Transmitters and receivers | Tagged 80m, beginners, manhattan-style, qrp, transceiver | Leave a reply

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Step attenuator kit →

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Touch Sensor

Introduction to DIY capacitive touch sensing, and the various type of touch sensor technologies.

Edited by Lim Siong Boon, last dated 14-Jul-09.

email: mail@siongboon.com
website: http://www.siongboon.com

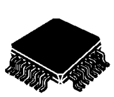
Topic Discussion Overview

1. Touch sensor IC and products

Various capacitive touch sensor products

Quantum Research Group

Capacitive touch sensor QT100, QT102, QT110, QT113, QT118H, QT220, QT240, QT1081, QT1103, QT60160, QT60168, QT60240, QT60248, QT60326, QT60486, QT411, QT511, QT1106



STMicroelectronics

The following circuit DIY touch sensor will be focusing oncapacitive sensing method. In case you think that capacitive is the only method to implement touch sensing, I have done some searching and list down the possible method and technology to achieve similar touch effect as the capacitive method. Just a short brief of the various touch sensing technology available in the market for your reference.

The various types of touch sensor.

- Capacitive
- Resistive "4 wire/ 5 wire/ 8 wire"
- S.A.W "surface acoustic wave", Acoustic
- InfraRed
- Camera

Capacitive type are normally used in a simpler button switch interface, which are commonly available on portable gadgets like mouse, ipod, and the On/Off switch for your LCD monitor. This method senses the changed of capacitance when the user come in close contact on the switch plate surface.

Capacitive touch sensor can be implemented using microcontroller with simple interfacing component. You may like to refer to Microchip or Texas Instruments website for implementing touch sensing using a microcontroller, mTouch.

PDF Article: Layout and Physical Design Guidelines for Capacitive Sensing

PDF Article: Software Handling for Capacitive Sensing

PDF Article: Capacitive Multibutton Configurations

PDF Article: PCB-Based Capacitive Touch Sensing With MSP430

Fortunately there are already integrated hardware solution in the form of IC chip, making it easier to integrate touch sensing into your gadget. On the left are some references for the various source of IC chip.

Capacitive touch sensor: QST108, QST1610, STMPE1208S
Resistive touch sensor: STMPE811

Omron

Capacitive touch sensor: B6TS-04LT, B6TS-08NF, B6TS-16LT

Sensor Platforms

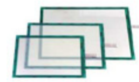
Capacitive touch sensor: SSP1401, SSP1492

Analog Devices

Capacitive touch sensor: AD7142, AD7143, AD7147, AD7150, AD7151, AD7745, AD7746, AD7747

The following are some of the touch solution available.

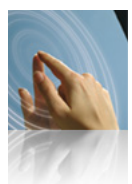
Resistive touch sensor is commonly deployed in our touch panel LCD monitor.



SAW acoustic sensor

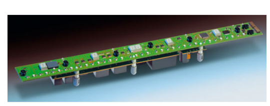
Piezo touch switch

http://www.danielsoneurope.com/products/piezo_switches/



Acroustic sound sensing, by sensitive object.

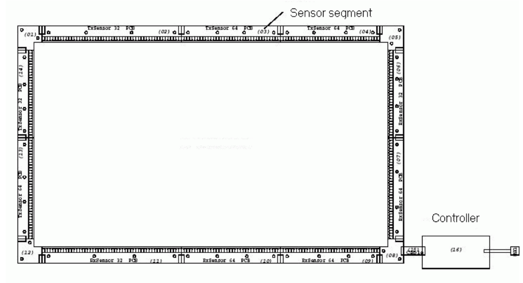
IR touch screen InfraRed



Cherry IR touch panel
A simple IR emitter and detector for touch sensing.

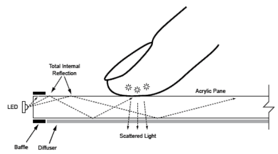
Another method of detection using IR sensor, by sensing the lights that is being blocked (the IR component looks like a LED).
http://web.ndak.net/jdgrotte/touchsensor/touchsensor.htm

IR sensor deployed in grid form, creating a IR sensing touch screen.



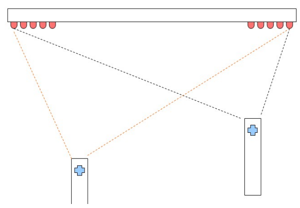
Touch technology base on camera.

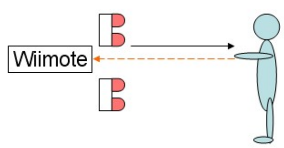
- [IR camera](#).



more:
http://www.instructables.com/id/How-to-Make-a-Cheap-Multitouch-Pad/1

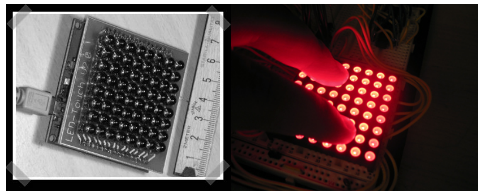
- [Whiteboard using the Wiimote](#).



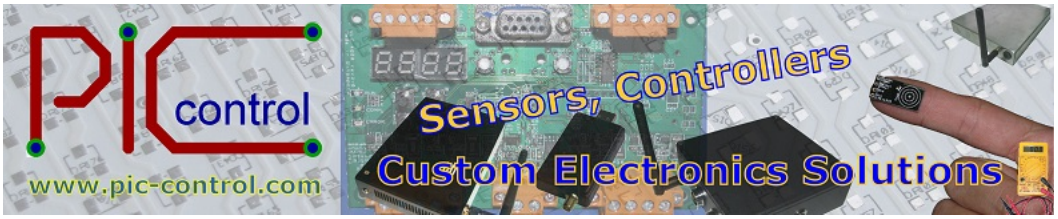


http://uiui.mmdays.com/2008/03/29/johnny-lee/

- LED Multi-touch panel (click the picture for reference)



Comparison references for various touch sensing technology.
PDF Article: [Touch Screen Technology Comparison](#)
http://www.tvielectronics.com/Touch_Screen.html
http://www.softtouch.co.in/compareTouch.htm



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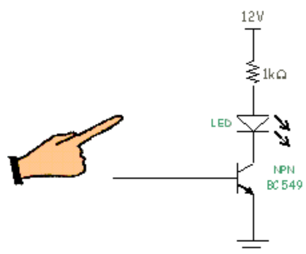
2. Touch sensor circuit

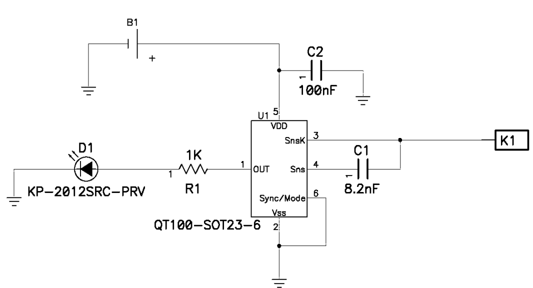
Simplest touch sensor circuit

The illustration on the left shows a simple touch sensor circuit. It will light up the LED when a person gets in contact with the wire or metal connection to the transistor base. This touch circuit is cheap and easy to construct. All you need is a npn transistor, a resistor, a LED, a metal contact surface and of course the wire connection. It is so simple.

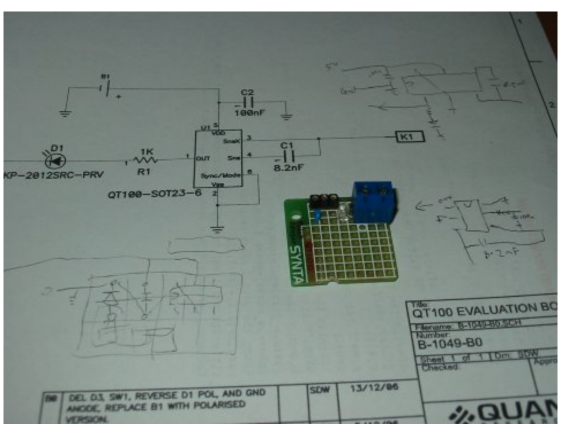
NOTE: Interface the circuit will requires a bit further improvement to the design. Do not connect the ground reference to the earth. The LED will either not light up or will be very dim.



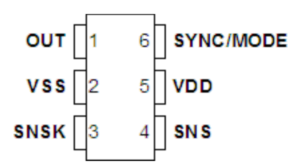
Capacitive touch sensor circuit using QT100



Touch sensor schematic. (click for larger image)



Using QT100



QT100 IC pin out

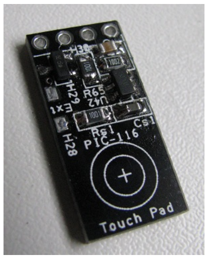
- QT100 datasheet
- QTouch design
- Touch sensor using spring
- AT42QT1011.pdf

Part no.

- **AT42QT1011** (touch on output)
- AT42QT1012 (touch toggle output)
- AT42QT1010 (touch pulse output)

Touch Sensor Module PIC-116

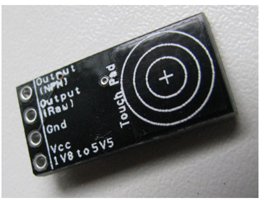
This touch sensor module PIC-116 from PIC-CONTROL uses QT100 IC to sense touch. You from PIC-store. The module is small measuring only about 21x10x3mm, making it easy to d button press application. The voltage supply Vcc required can be from 1.8V to 5.5V.



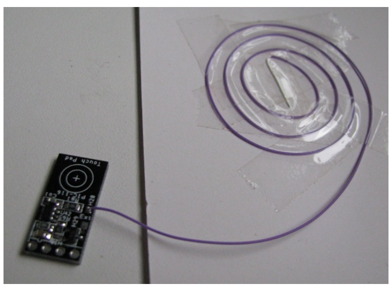
There is two output provided. Pin 2 is a digital output logic 0 and logic 1. Logic 1 indicate: Logic 0 will be a 0V, while logic 1 is a voltage that is same as Vcc (supply voltage). Pin 1 is a will force this pin 1 to ground, while logic 0 will leave this pin floating. Pin 1 is useful if the a drive directly a load of not more than 40V 0.5A. The load can be a LED indicator or the coil higher current load. This means that it can be use as a momentary switch to switch on virtually

The touch sensitivity can be adjusted by changing the capacitor Cs. PIC-116 mini touch installed with a Cs value of 8.2nF. The sensitivity can be reduced by using a lower capa minimum Cs value is about 2nF. A Cs value lower than 2nF can have undetermine output sta sensitivity, a higher capacitance of Cs can be used. Maximum Cs value is about 50nF.

The sensor can be so sensitive that it can detect your finger or body a few centimeter away fror



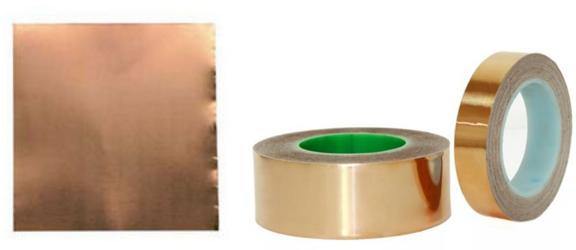
The reverse side of the PIC-116 touch sensor module is completely flat, making it easy to hide glass or plastic plate as a user interface. The intergrated sense pad onboard is on this side of th the 3 circled ring with a pad area of about 10x10mm.



The sensor comes with a soldering pad to allow me to use my own sensor pad. I have coil a wraping wire (thickness 0.5mm) as a touch pad. One end of the fine wire is soldered to the pad which is also next to the component Rs. This coil allows me to customised my own touch p and shape. The coil on the left is about a diameter of 50mm. A big touch pad makes it easy fo with.

wire wrapping wire. Fine wire, dia of about 0.5mm

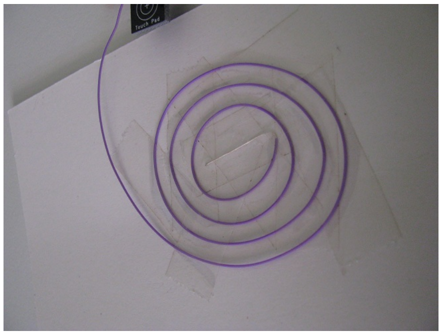
Alternative, this "Ext" pad can be soldered to copper foil or copper tape (thickness 0.08mm) v thinner than my wire wrapping wire. A flat touch pad can be easily conceal behind poste allowing the touch switch to be hidden flat. This is great if you need an odd size/shape/surface interface to blend into your designed artifact; which is impossible using a typical off the shelve switches. Compare to a mechanical switch, touch switch do not have the problem of mechan You can get the copper foil from stained-glass shop. Copper foil tape is used as adhesive to hold the glass that was cut to shape.

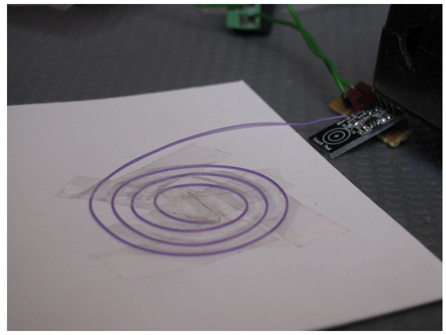


copper foil, copper foil tape, easily available from stained-glass shops

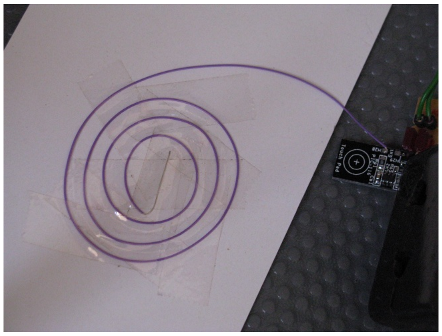
After my external wire coil is soldered onto the "Ext" pad, the sensor becomes more sensitive increase in the pad area. The larger the pad size, the more sensitive it will become. The larger the sensor to capture from a larger area. In order to reduced the sensitively, a smaller capacitan

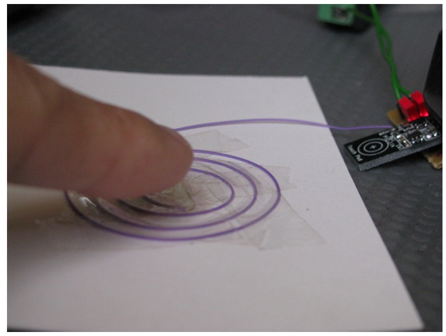
The touch pad should be of a size of the sense target. If the finger is expected to touch the should be of the finger size which is about 10x10mm. If a palm/hand/leg touch is expected, th larger.





Sensor will not response when nothing is near its sense pad.





Sensor detects my finger at a close proximity to the pad. A physical touch is not neccessary
sensitivity that was set by the capacitor Cs. The sensitivity can be set lower, so that the sensor
upon a physical touch on the sense pad.

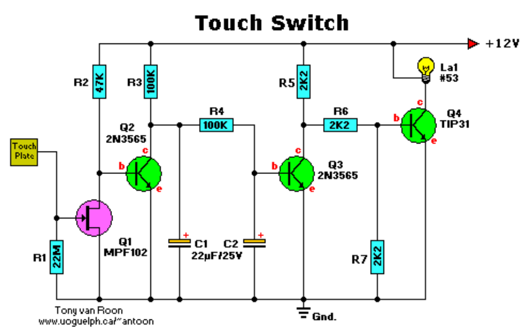
Video of the touch sensor PIC-116

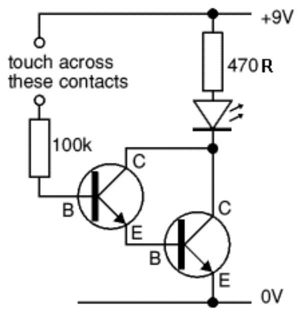
[MVI_1615, finger touch switch.AVI]
Video showing the sensor response to a finger at close proximity. Notice the sensor is able to detect the finger even before the finger touches the pad. The sensitivity was set too high. Cs can be lower to reduce the sensitivity so the the sensor gets activated when the finger is in contact with the pad.

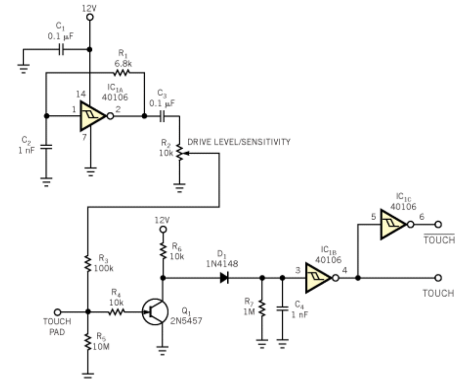
[MVI_1616, sensor sensitive to metalic.AVI]
Video showing a piece of aluminium foil material activating the sensor. The sensor is too sensitive in this case. This can be eliminated by lower the capacitance Cs, so that the sensor is robust against such foil at close proximity. Radio radiation and electrical power line can also affect the result if they are placed near the sensor.

[MVI_1620, touch sensor through material.AVI]
The sensor is able to detect my finger touch even through insulated material like plastic or wood. The sensitivty of the sensor will need to increase in order to sense a finger touch across a much thicker insulated material >5mm.

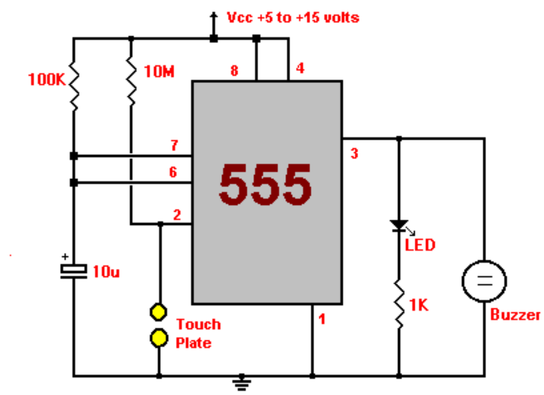
Various others touch circuit that I have found on other website:

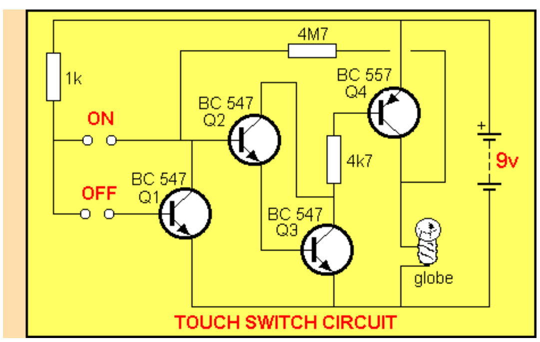


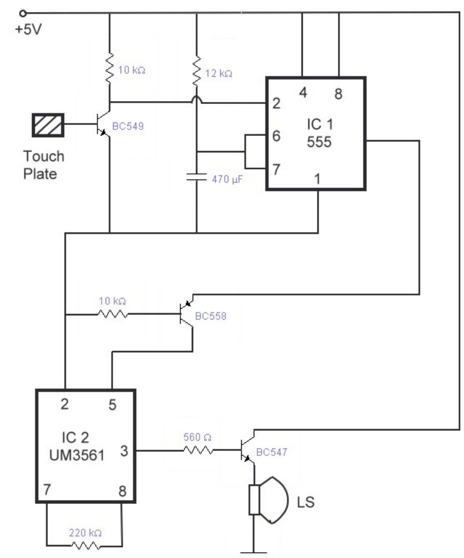




A low-cost touch-switch interface uses three Schmitt trigger hex inverters and a single JFET per channel.



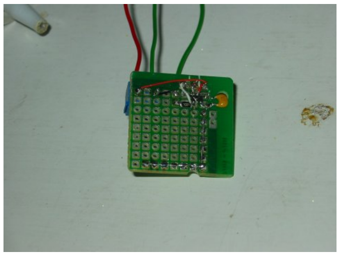


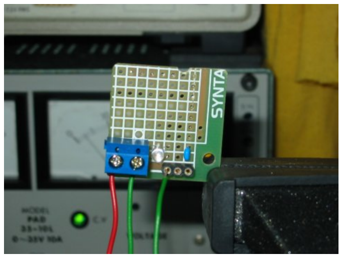


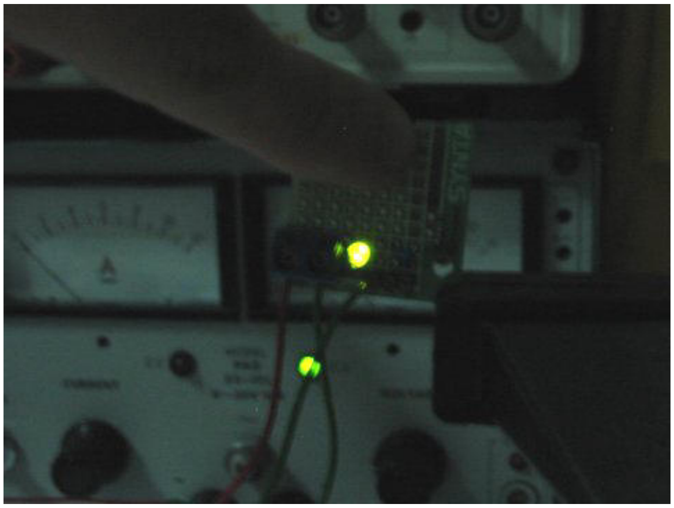
3. Touch sensor in action

Testing out with my first touch sensor prototype board. It is actually more sensitive than expected. The sensor board can sense my finger at a distance of about 10mm. The circuit is quite simple to setup with only a few passive resistor and capacitor components.

I am suppose to make the board a plate for sensing the capacitance, but I only wired the sensing plate in a form of L shape path. It is working well just like a rectangular sensing







zone, even though the plate is actually a thin L shape path.

One thing I found out. It is too sensitive. the sensor also detects if I place the board near my wooden table platform. You can actually fine tune the sensitivity by using a different capacitance component.

Try reading the datasheet for further information on using QT100 touch sensor. You can find more tips on making your own touch sensing device.

The following videos demonstrate the signal out put you can expect from QT100 touch sensor IC.

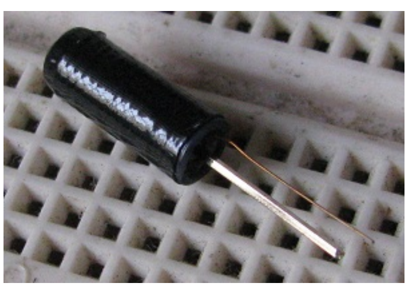
MVI_4968.AVI

Touch sensor is sensitive

MVI_4970.AVI

MVI_4969.AVI

4. Touch Vibration Motion Sensor



This is a simple vibration detection switch. The switch will make a contact upon slight vibration or motion.

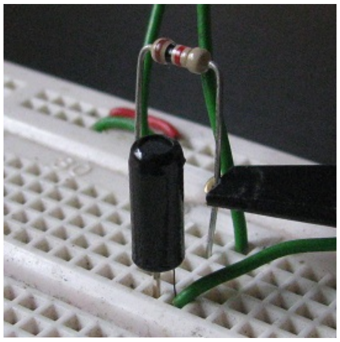
Typical application for this sensor
- vibration detection (detect vibrate on an object)
- touch sensor (motion touch of finger/hand)
- knock sensor (door knocking)
- centrifugal force sensor (detect the present of centrifugal force on a machine or motor)
- detect sudden motion (sudden change in motion)

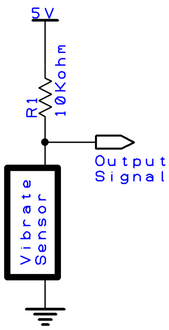
The picture and schematic on the left presents a simpe circuit to test the sensor.

The output signal is a digital on and off signal, like a random noise or glitches. The change of signal's logic indicate that there is a vibration or knock present. The output state of the sensor at rest will be logic 1 (5V); the sensor is a open switch at rest position.

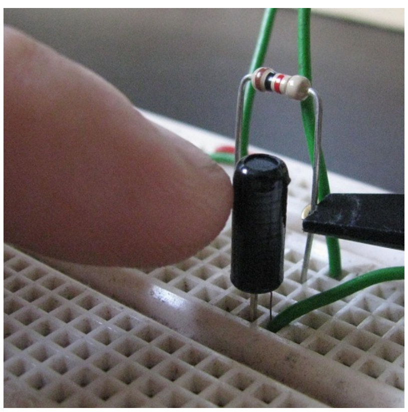
When the sensor is subjected to a centrifugal force, the sensor will be at close position, with its output staying constant at logic 0 (0V).

The output signal is quite raw, but can be easily intepreted from a micrcontroller to detect the vibration event.





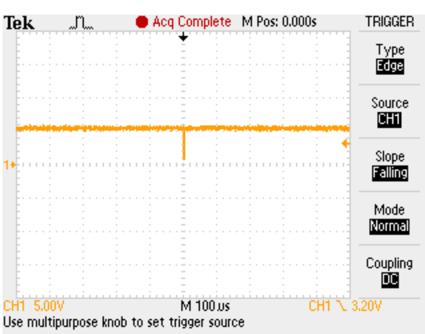
A simple schematic of the vibrate sensor circuit under testing.



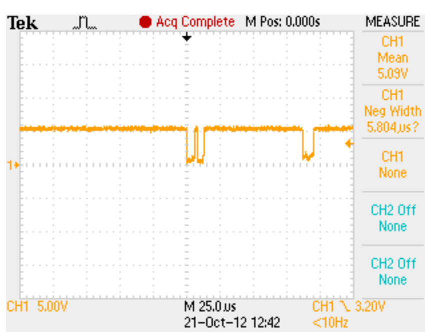
My finger giving the sensor a slight knock.

The sensor is a very sensitive touch switch. Any finger knock on the physical sensor will trigger an output response.

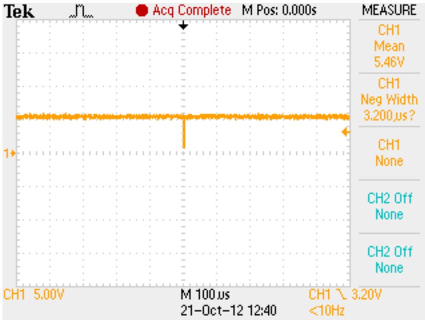
The following signal is taken from the output signal of the vibrate sensor. The output signal of various knock and vibration. Some slight touch, while some very hard hit on the sensor.



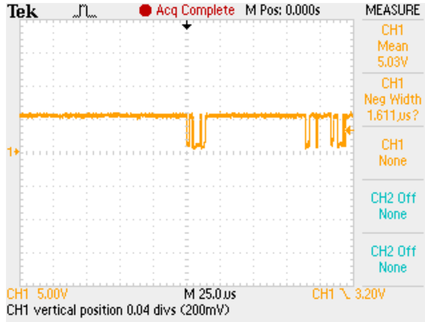
slight knock



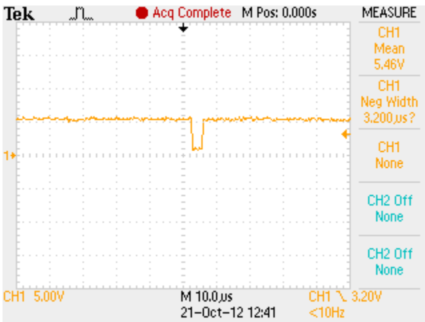
harder knock



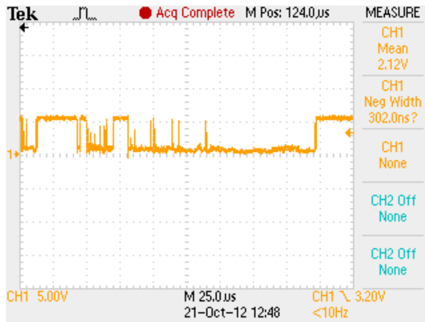
slight knock



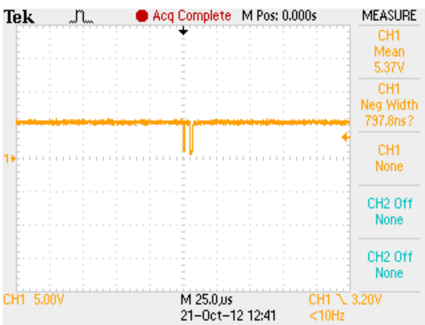
harder knock



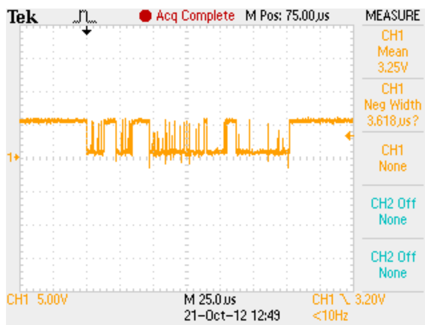
slight knock (zoom in). It is actually a short negative pulse of about 5us.



vibration



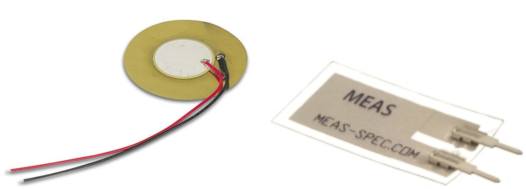
slight knock with a double pulse detected.



vibration

A permanent logic 1 or 5V will occur when the sensor is subject to a centrifugal force.

5. Piezo Touch Sensor



Touch sensor using piezo was what I would have never though o use of piezo, but using it as a touch is over-whelming to me.

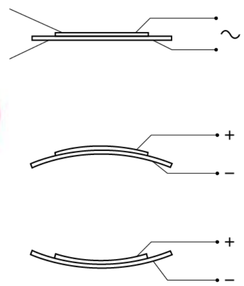
I have searched the website for more information about piez consolidate them below.

This is how a plain piezo sensor looks like. It consist of two plate v input voltage (use as a speaker), and generate voltage whe microphone).

Using piezo as a buzzer.

Alternating voltage is applied to the wire pair which will vibrate t sense, it works like a speaker.

A illustration of how the piezo sensor, 2 plate generate voltage w bends when voltage is applied.



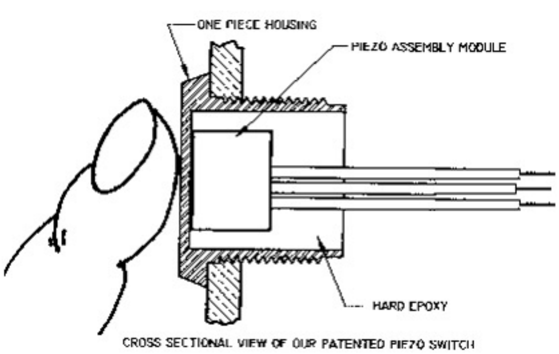
Throat microphone using piezo.

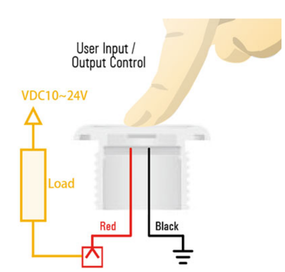
Normal microphone depend on the sound wave through the air. So
a distance can be pick up by the mic. A throat mic is held close t
up the vibration from our voice. This can prevent the distance no
up, but it also has its own source of noise. Anything that can vi
will be the potential source of noise for the throat mic.

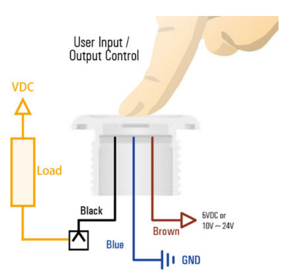
Ultrasonic Transducer using piezo plate.

This sensor is widely deploy on a vehicle as a parking sensor. The
a warning buzzer when it detect an object behind the vehicle. The
ultrasound wave and any object in the path of the wave will reflec
back to the sensor. A detection of the reflected sound will indicate
the sensor. It works is like the bat flying in the dark using their ear

taken from http://piezo-switch.com/index-2.html







Piezo sensor as a touch switch.

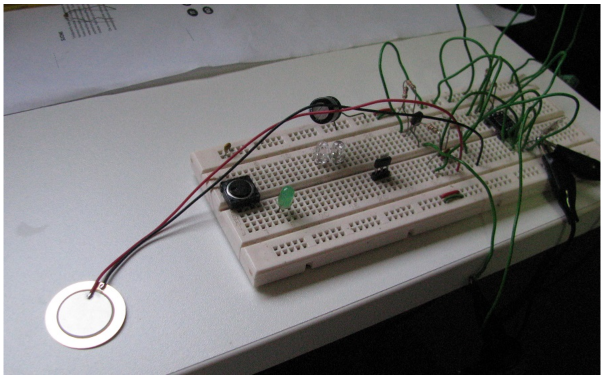
Using piezo as a touch switch has many advantages over other typ

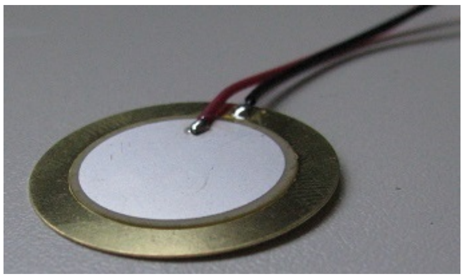
- durable, waterproof

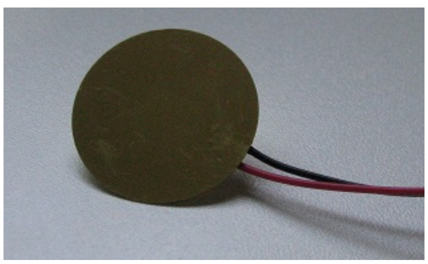
- easy to maintain, long lifespan

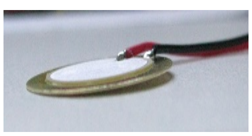
- robust to RF, capacitance interference.

The piezo schematic that I have tried out:



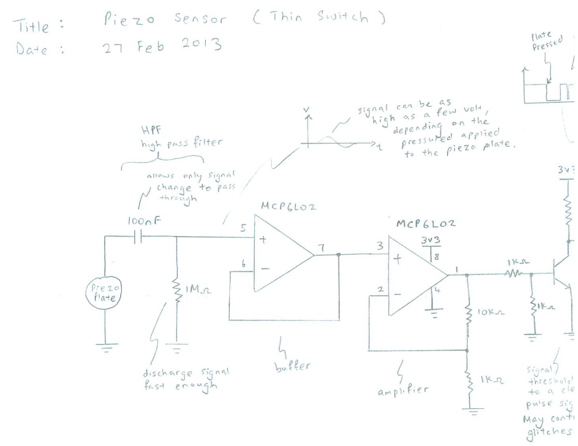

ceramic back side of the plate.


front side of the plate.

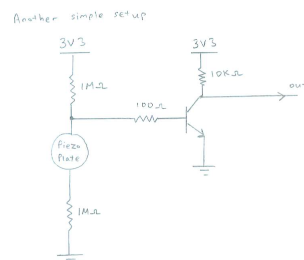

side view showing the piezo, a very thin plate.

My flat and ultra thin user button switch.

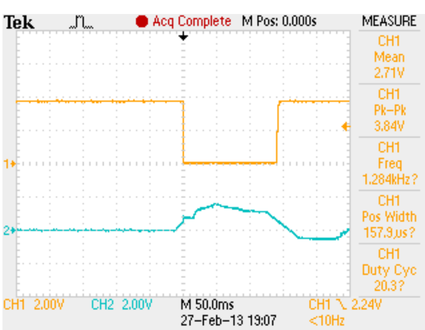
Schematic making use of piezo plate as a touch button push swi
activate with a light tap on the piezo plate.



A simpler schematic to use the piezo plate as a switch.



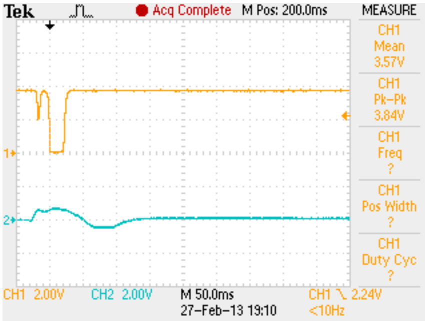
Some of the signal taken on the piezo output and also the processed switching signal.

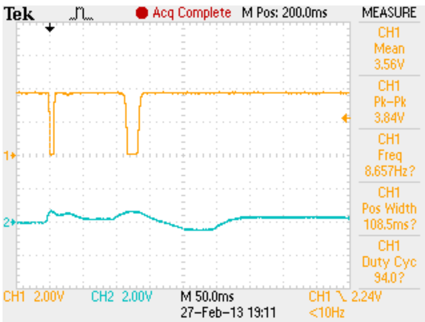


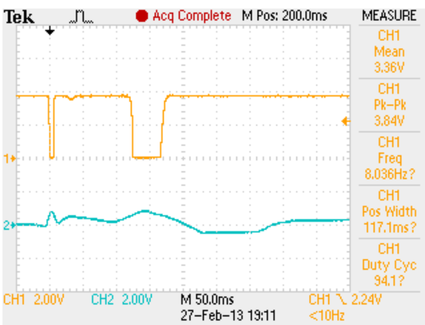
Ch1 (yellow) is the npn transistor output.

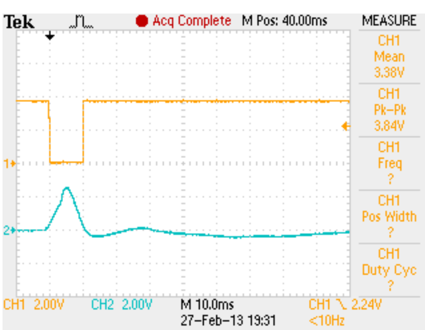
Ch2 (blue) is the signal taken at the piezo out. Signal can reach as
When pressure is applied to the white ceramic back side, the signal
positive curve, followed by a negative smaller curve. The opp
generated if the pressure is applied from the front face.

I managed to play around with various design. Some design, the
which result in glitches. Overall the piezo is quite simple to in
activate the sensor, but not as bad as I had imagine. This undes
filtered with proper design.

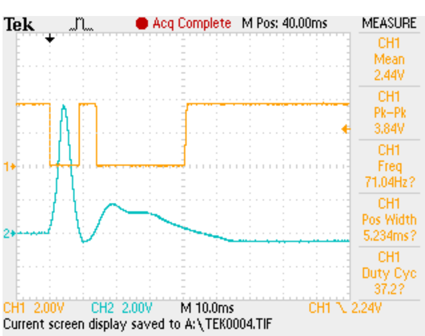




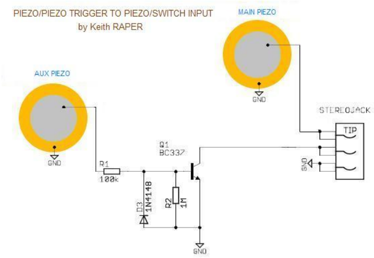


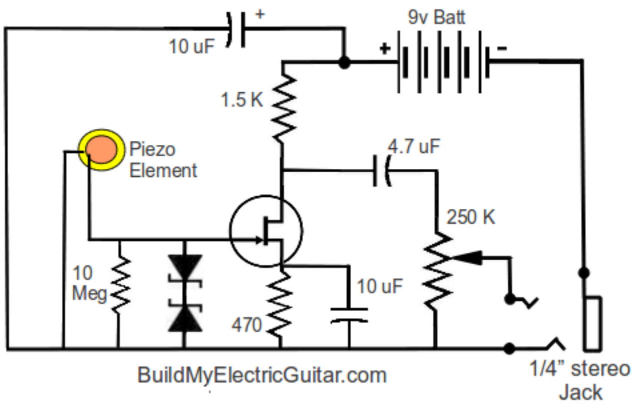


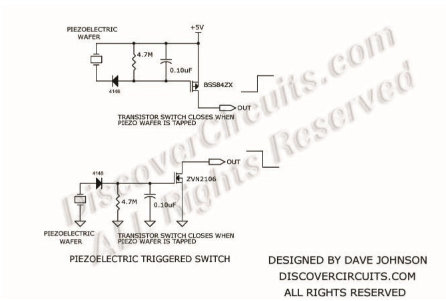
Signal taken with my final op-amp schematic design as posted pulse has a much cleaner cut.

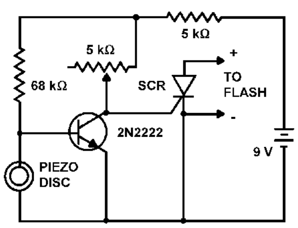


Piezo touch sensor circuit taken from other website









email: mail@siongboon.com
website: http://www.siongboon.com

Keyword: Touch sensor switch, proximity, capacitance, capacitive touch sensing, surface acoustic wave, resistive 4 wire 5 wire

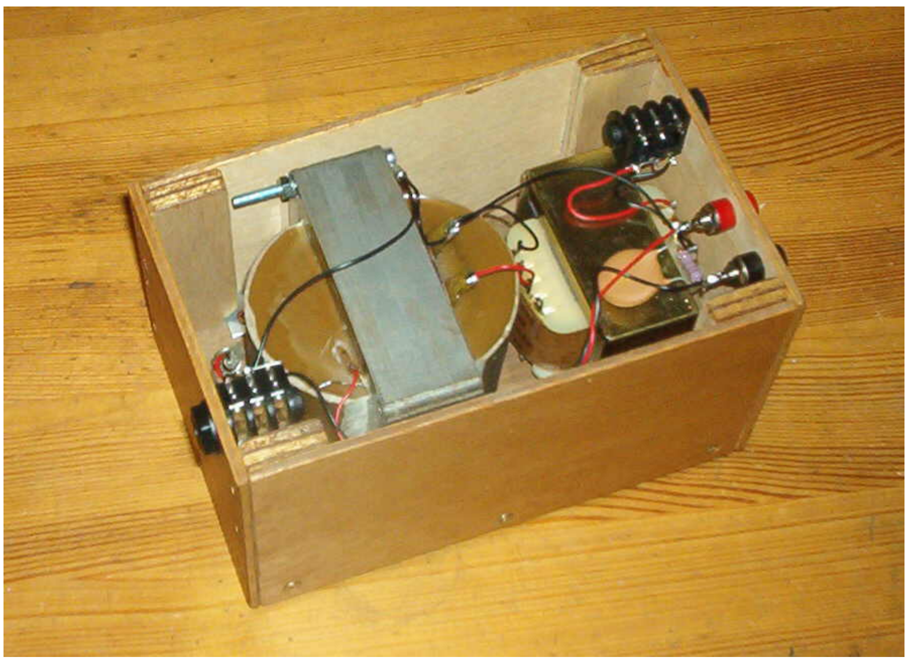
Transformer unit 1

Back to the index

If we use in our crystal receiver a detector circuit with a very high Q, then the parallel resistance of the circuit will also have a very high value.
The load impedance which we connect to the circuit, must also have about the same value.

Example:
A circuit has at 1000 kHz a Q of 1200, the induction of the detector coil is 0.2 mH.
The parallel resistance (Rp) of the circuit will have a value of Rp= 2.pi.f.L.Q= 1.5 M.Ohm (Mega-Ohm).
At other frequencies there is another value for Rp, because both f and Q will change.

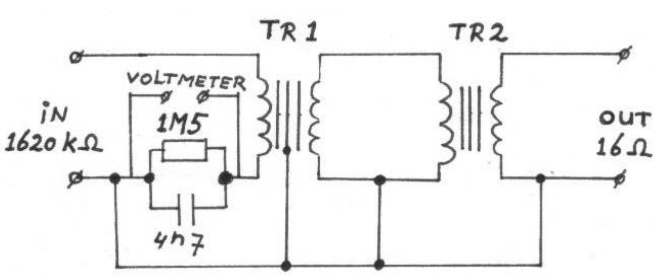
The transformer unit discribed here has a input impedance of 1.62 M.Ohm so it is very suitable for loading high Q circuits in crystal receivers.
I build a separate unit for it, so it can be used for several crystal receivers, and also because I only have one piece of the special input transformer (Tr1).



Transformer unit 1

Transformer unit with a input impedance of 1620 k.Ohm.
And a output impedance of 16 Ohm.

The large transformer on the left is Tr1, the other is Tr2.
The dimensions of the unit are: 18x11x10 cm.



The transformer unit is build with two transformers.

Transformer Tr1 comes from a high voltage power unit, brand "Simco Nederland b.v." and type number A257C1-6.
The transformer has a primary coil which was connected to 220 Volt 50 Hz via a 910 Ohm series resistor.

The secundary coil gives 7 to 8 kilo-Volt at 2.5 mA.
So this secundary coil has a very high impedance.

In my transformer unit the input signal is connected to the secundary coil of Tr1, and the primary coil of Tr1 is connected to Tr2.
So the primary and secundary coil have changed function, and Tr1 now works as a down transformer.

With different load resistors, I measured the following properties of Tr1:

- Input impedance
- Frequency bandwidth (-3dB)
- Efficiency

A test method for these measurements, you will find here.
The results are in the following table:

Load resistance Ohm	Input impedance kilo-Ohm	Frequency range -3 dB (Hertz)	Efficiency
68	524	140-4600	0.733
100	730	150-4500	0.808
150	980	150-4120	0.806
220	1338	150-3400	0.794
330	1815	160-2700	0.761

Behind Tr1 I placed a second transformer (Tr2) which transforms the voltage and impedance further down.

Tr2 is a audio transformer for 100 Volt loudspeaker systems.
It's brand is Adastra and type number 952.446.
On the primary coil, I used the 40 Watt connection, which has a impedance of 250 Ohm.
The output impedance of Tr2 is 8 or 16 Ohm, I use the 16 Ohm connection.

De complete transformer unit has the following specifications:

Input impedance: 1620 k.Ohm Output impedance: 16 Ohm Frequency range (-3 dB): 150--2700 Hz. Ratio input voltage / output voltage: 377 Efficiency: 0.71

The resistor and capacitor in the schematic are added to become a DC resistance for the unit which is the same value as the impedance, this is important to prevent sound distortion when receiving strong stations.
Over the capacitor we can measure a DC voltage, which indicates the strenght of the received station.
Use a voltmeter with at least 10 M.Ohm resistance for this.

The ground connection of all coils and the iron core of TR1 are all connected to each other, this prevents picking up hum.

In this setup (secundary coil of one transformer connected to the primary of another transformer), we must multiply the efficiencies of both transformers, to become the efficiency of the complete unit.

when I connect a driver unit to the output of the transformer unit, a 1 kHz test tone on the transformer unit input with a amplitude of 1 mV peak-peak can be easily heard.

We can still use the transformer unit as a up transformer, for instance by connecting a signal generator to it's output.
This is very dangerous, because the voltage at the input of the transformer unit can now easily reach thousands of Volts.
But for experiments this can be usefull, that's why I used a 4kV type for the 4n7 capacitor, so it can not be distroyed so easily.

Back to the index

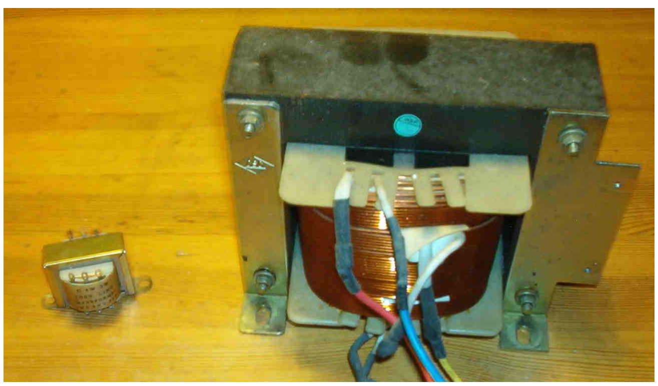
Transformer unit 2

Back to the index

This transformer unit is build around a self made transformer with a very high impedance.

We get the high impedance by placing several transformer coils on the same core.
If we place several coils (number=N) on the same core, and connect the coils in series, the impedance will increase with a factor N^2 .
In addition we can load the transformer output with a higher load resistance then where it was designed for, this will increase the input impedance even further.

For the construction of the transformer we need:
6 audio transformers with an impedance of 40 kΩ (I used 100V audio transformers brand: Adastra, model: 952.434).
1 old power transformer, with a power rating of 1000 to 2000 Watt, this transformer may be defective, we only use it's iron core.
The coil height of the big transformer must be at least 3 times larger then the coil height of the small audio transformers.



The ingredients of the self-made transformer:

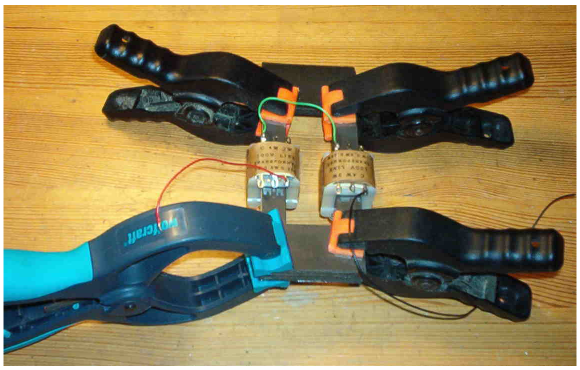
Left: 40 kΩ audio transformer (we need 6 of them).

Right: a big old power transformer

From the small audio transformers we remove the iron core.
The core is build with E and I shaped metal plates, which are sticking together with some lacquer.
Removing the first E plate is quite difficult, I put the transformer core in a vice, and pulled out the plate using two pliers.

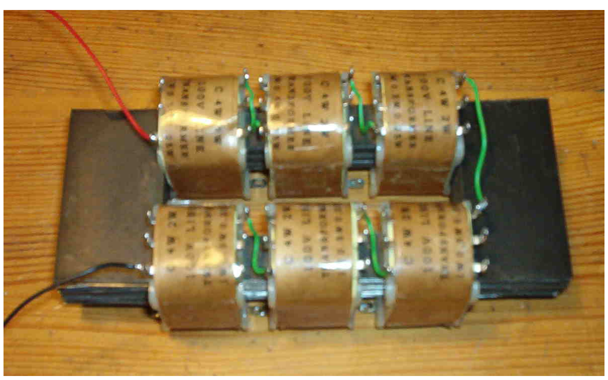
From the large transformer, we remove some E and I plates (we don't need all of them).

With a metal cutter, we cut out of each E plate, two U-shaped plates which fit precisely into the small transformer coils.
Out of each I plate we cut two short strips.
With these plates, we are going to make a new transformer core.



Before I dismantled all 6 audio transformers, I first did a test with two coils on the self-made iron core.
One coil was loaded with 16 Ω at the 16 Ω output, the other coil's output was not loaded.
The two 40 kΩ coils were series connected, the measured impedance of these two coils was 152 kΩ.
The -3 dB bandwidth was 170 - 5300 Hz, en the efficiency 0,688

This looks promising...



Now all 6 coils are mounted on the transformer core.
Note: 3 coils on one side are pointing in the same direction, the 3 coils on the other side are pointing in the opposite direction.
The U plates are alternating put in from the left side and the right side into the coils.
The strips are places at the end of the U plate, so a closed core is formed.
On the part of the core outside the coils, some lacquer is applied, this prevents the core from falling apart.

Properties of the transformer with 6 coils in series.

The 6 coils of 40 kΩ are series connected.
In the next measurements, the output of one coil is loaded with several resistor values.
From the other 5 coils the outputs are not loaded.
On the coils, the following connections are available at the output: common, 8Ω and 16Ω.

Table 1

	Input impedance	Bandwidth	Efficiency

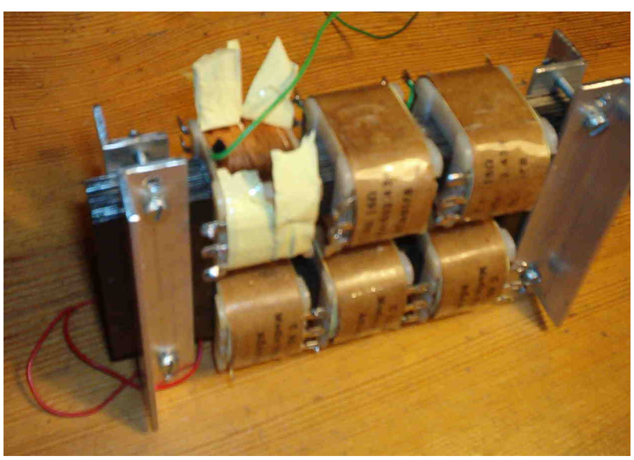
	at 1 kHz	-3 dB	
16 Ω output loaded with 16 Ω	1500 kΩ	230 - 3100 Hz	0.73
8 Ω output loaded with 16 Ω	2500 kΩ	370 - 3300 Hz	0.73
8 Ω output loaded with 32 Ω	3840 kΩ	510 - 2900 Hz	0.63
8 Ω output loaded with 64 Ω	5740 kΩ	700 - 1920 Hz	0.50
16 Ω connected between 8 Ω and 16 Ω output	6350 kΩ	710 - 1800 Hz	0.36

With a load of 4 times the normal value (8 Ω output loaded with 32 Ω) both bandwidth and efficiency were still acceptable.
The loudspeaker I generally use as load, has an impedance of 16 Ω.
I decided to make an extra tap on the coil which corresponds to 4 Ω, so the 16 Ω loudspeaker forms a load of 4 times the normal value.

Making a 4 Ω tap on the coil.

To make an extra 4 Ω tap on the coil, we must remove the paper and tape from the outside of the coil.
We now reach the outside layer of windings of the 16 Ω coil.
Connect a 1 kHz signalgenerator to a 16 Ω output of one of the other coils.
Connect an oscilloscope to the 16 Ω output of the opened coil (so measure the voltage between common and 16 Ω connection).
Adjust the amplitude of the signalgenerator, so you measure 1 Volt on the oscilloscope.
When you measure the 8 Ω output, the voltage will be 0.71 Volt.
Try to find a winding on the coil, where the voltage is about 0.5 Volt, this may be in regard to the common, the 8 Ω or the 16 Ω connection.
The voltage of 0.5 Volt corresponds to a impedance of 4 Ω.
To measure the voltage of the windings, we must pierce the tip of the oscilloscope probe through the insulation of the windings.

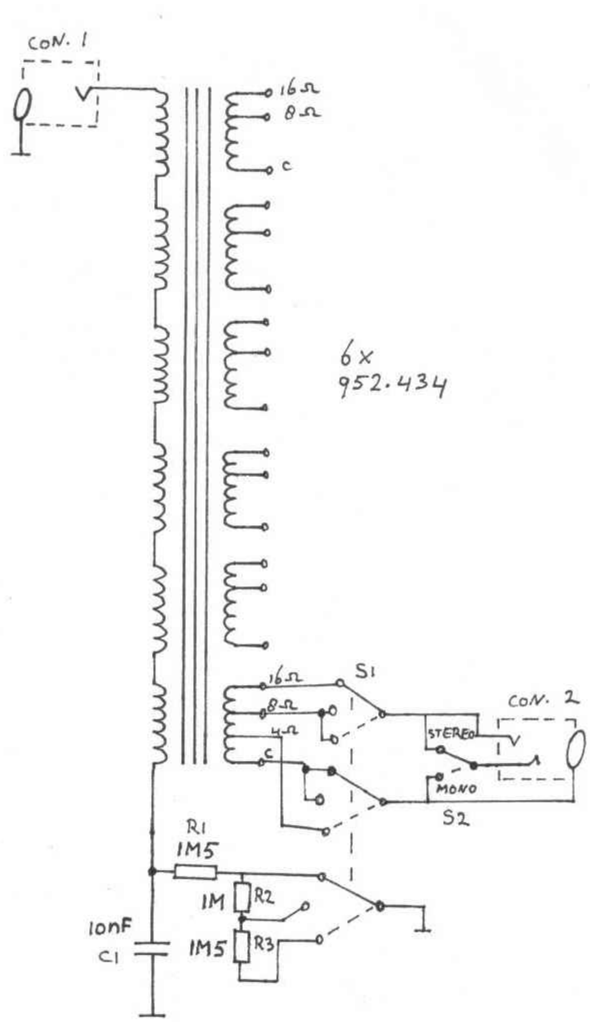
In my case, I found a winding where the voltage was 0.46 Volt related to the 8 Ω connection, on this winding I soldered a wire (see the next picture, the green wire on the opened coil).



To increase the voltage further from 0.46 to 0.5 Volt, I made 4 extra turns with the wire around the transformer core.
Now we have a connection with an impedance of 4 Ω in regard to the 8 Ω connection.

Extra information:

With each extra winding, the voltage increased 0.01 Volt, while the voltage over the 16 Ω output was 1 Volt.
This indicates the total 16 Ω coil has about 100 windings.
The impedance ratio between input and output of one coil are: 40000 Ω / 16 Ω = 2500.
The ratio in the number of windings is equal to: √2500 = 50.
So the number of windings of the 40 kΩ coil must be about 50 x 100 = 5000.



Circuit diagram of transformer unit 2.

Con. 1 is the input connector of the transformer unit.

Via switch S1 the input impedance can be set to one of the following three values.
- 1.5 MΩ (switch in upper position)
- 2.5 MΩ (switch in middle position)
- 4.0 MΩ (switch in lower position)

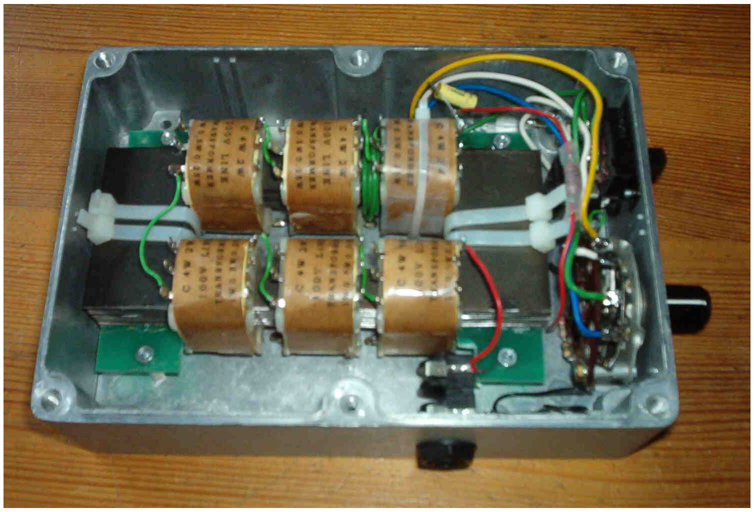
Con. 2 is the output of the transformer unit, we can both connect a mono, or stereo plug to it, of course the audio will always be mono.
Via switch S2 we can choose between a mono or stereo plug.
Con. 2 must be loaded with 16 Ω (mono) or 2 x 32 Ω (stereo).

The self made "4Ω" connection has in this case an impedance of 4Ω related to the 8Ω connection.

Con.1 = 6,3 mm mono socket
Con.2 = 6,3 mm stereo socket

To mount the transformer in the enclosure, I first used aluminium profiles, which made contact with transformercore and enclosure.
But this was giving extra capacitance between the coils and ground (enclosure), and this reduced the transformers bandwidth.
Later I mounted the transformer insulated in the enclosure, in the position 2.5 MΩ this gave 200 Hz extra bandwidth.

The transformer, insulated mounted in the aluminium box.
The transformercore makes no electrical contact with the box.



The transformer unit, ready for use.

Table 2: Properties of transformer unit 2:

Switch in position:	Measured impedance at 1 kHz	Bandwidth -3dB	Efficiency
1.5MΩ	1.5MΩ	220 - 3250 Hz	0.68
2.5MΩ	2.5MΩ	360-2600 Hz	0.73
4MΩ	4.0MΩ	510 - 1740 Hz	0.66

When measuring the bandwidth, it is important that the input capacitance is as low as possible.
Every extra capacitance will reduce the bandwidth (at high frequencies).
With the capacitance of the input plug (± 5 pF) the bandwidth was: 510 - 1740 Hz (in de position 4 MΩ).
Without the input plug (directly measured on the transformer) the bandwidth increased to 510 - 2100 Hz.

When the transformer is outside the metal enclosure, the bandwidth is even higher (see values in table 1).
The use of a larger enclosure will probably increase bandwidth, because the capacitance between coils and enclosure reduces.
Also we can use a non metal enclosure, but with the risk the transformer picks up hum.
An aluminium enclosure also provides a screening between the coil of the crystal receiver and the iron of the transformer, this reduces loss of Q factor in the receiver coil. (see also [experiments with LC circuits](#) measurement 55).

Back to the index

Switch USB
USB switch

This circuit makes it possible to disconnect a USB device pernamently connected to the PC motherboard (ie card reader in PC case) if not in use.

Description involvement

In my PC I have a built-in panel that includes, in addition to a thermometer, fan regulator and various connectors, and a universal card reader. This reader is connected via a cable to a USB port on the motherboard. Because I did not like the fact that 4 "drives" are still displayed in the Windows Explorer, even if no memory card is inserted, I decided to make a switch to connect the reader only when it is needed. Although the reader uses the USB 2.0 interface, it works with the switch without any problems. I tried the switch successfully with a USB flash drive and MP3 player (all USB 2.0).

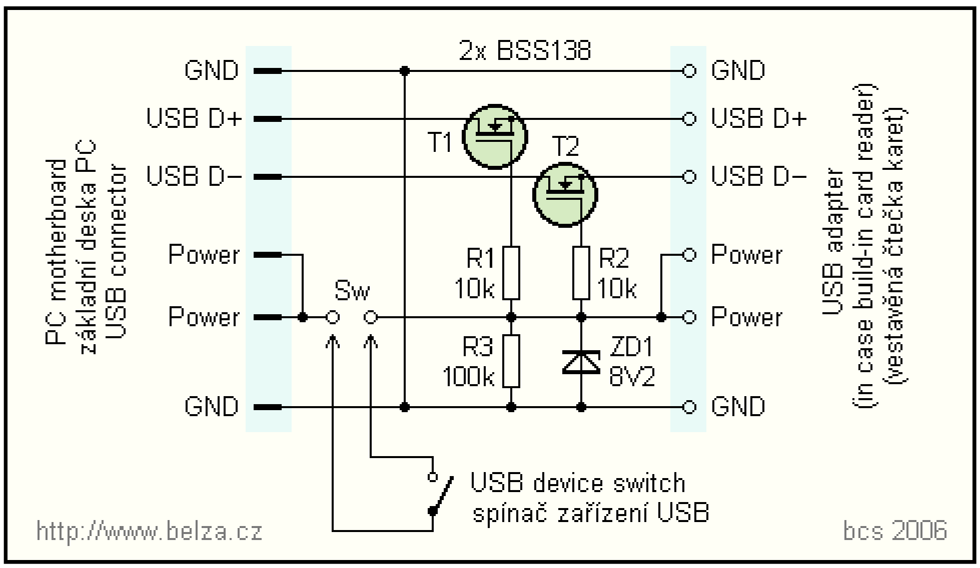


Fig. 1. Connect the USB switch
Fig. 1. USB switch circuit drawing

The connection of the switch is **shown** in **Fig. 1** . I used the MOSFET transistors to switch the data signals. The external switch connects the power supply to the USB device and at the same time, this voltage is applied to the gate of the transistors. Since data is transmitted at high velocity and the parasitic capacitances of the transistors are large, the transistor control electrodes are separated by resistors R1 and R2. Before connecting the switch to the USB, the transistors are not protected from destruction by static electricity. We therefore write them on the board as the last one and I recommend that the circuit board data be shorted to the power supply, see photo below.

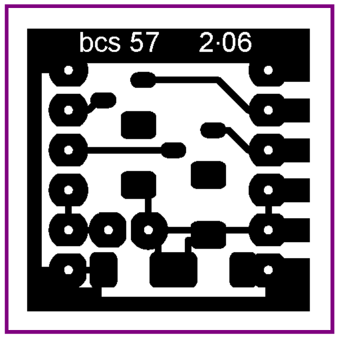


Fig. 2. USB Circuit Board Circuit Board.
If you use the right mouse button and choose "Save picture as",
you will get the 600 dpi link template.
Figure 2. USB switch PCB layout.
Click right mouse button and choose "Save image as" to get 600 dpi resolution image

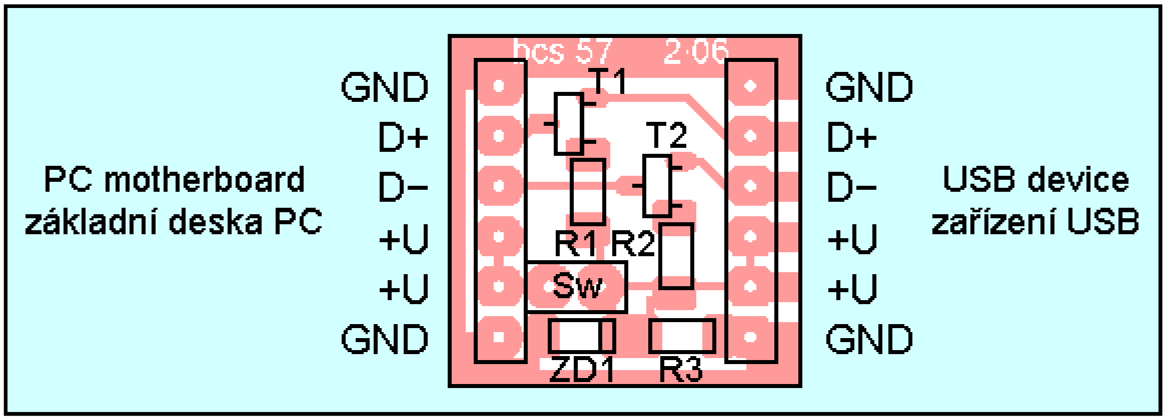
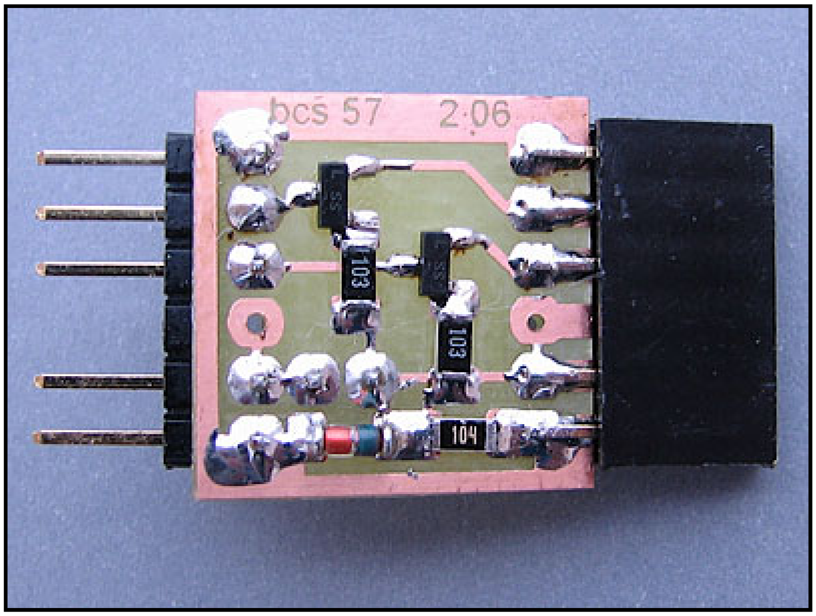
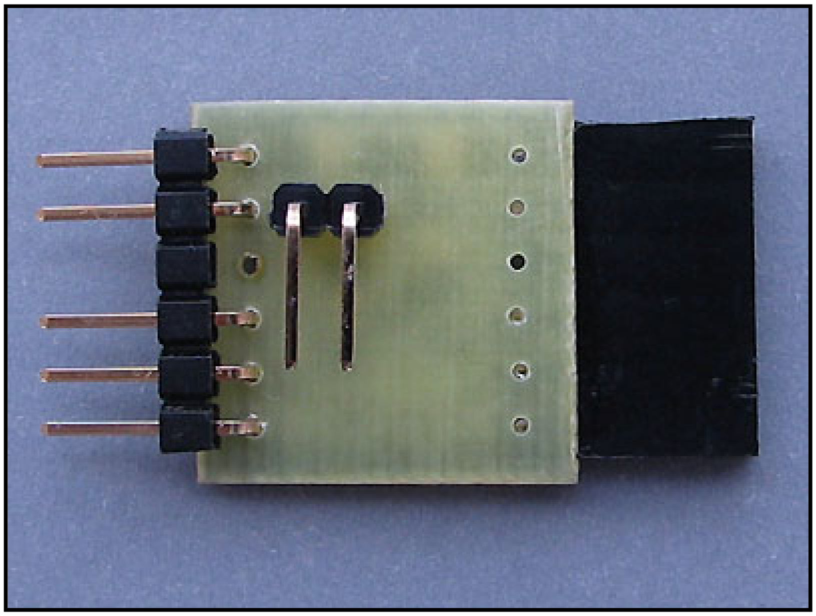


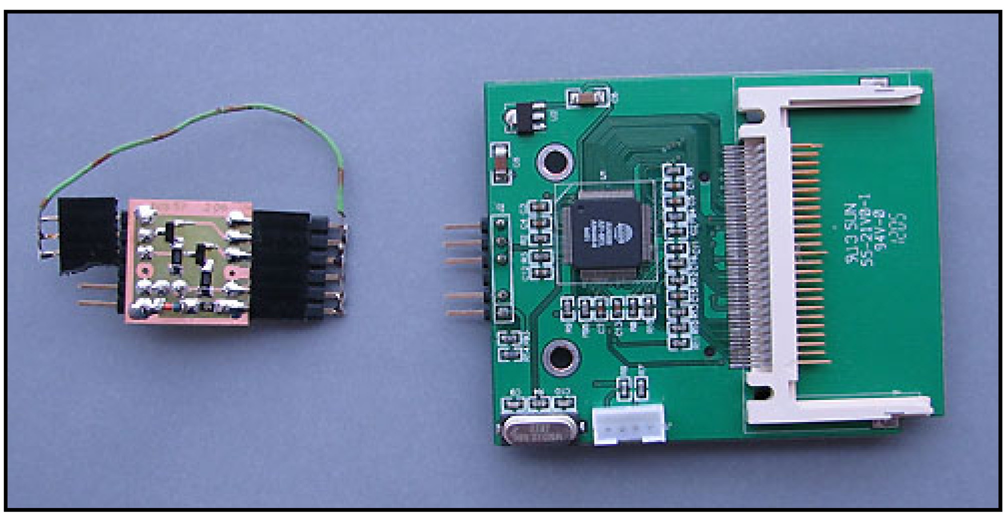
Fig. 3. Layout of USB switch components
Figure 3. Locations of components on the USB switchboard

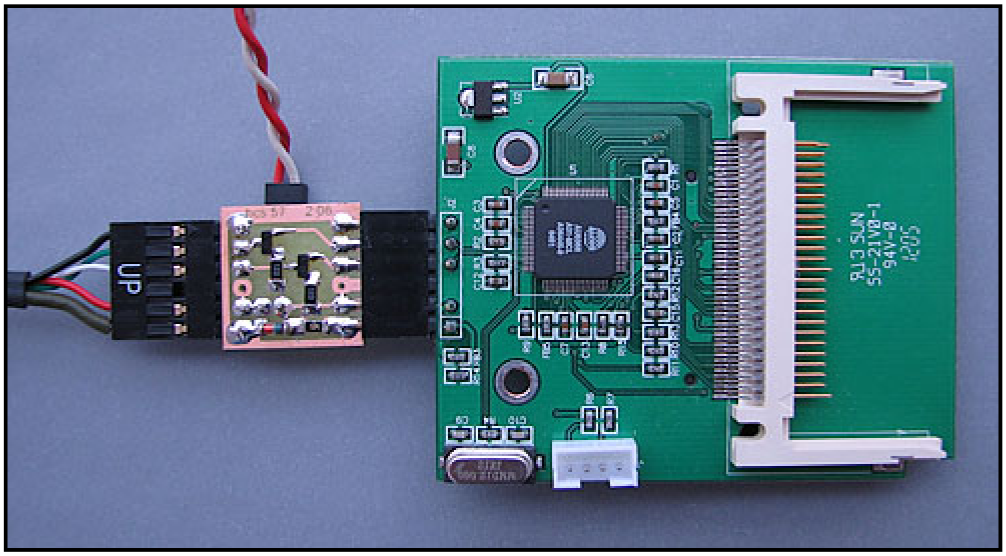
List of parts

R1, R2	10 kohm, SMD 1206
R3	100 kohm, SMD 1206
ZD1	8V2, SOD80 Zener. diode (6V8 to 18V)
T1, T2	BSS138, SOT23, code mark SS
Sw	external switch / external switch
	4 or 6 pin pin header 4 or 6 pins header
	4 or 6 pin 4 or 6 pins plug
	PCB board bcs57


bcs 57 2.06
103
103
104







Jaroslav Belza

The USB switch was printed in "Practical Electronics" 4/2006, p. 15

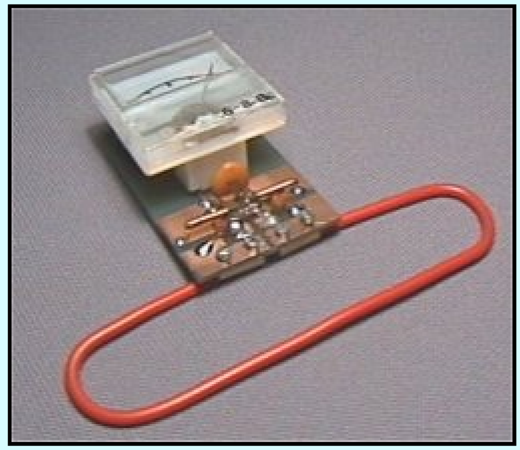
14. 4. 2006

RF signal detector

Back to the menu: Measurements - General index

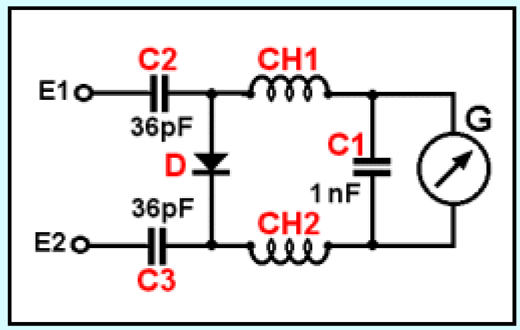
See also: **- Realization of a voltmeter - Measurement of an HF current in a conductor - Realization of a line of Lecher - The coils of chokes or chokes -**

Use



This detector was initially designed to be used with a line of Lecher.
It is an ammeter (in current detector with a loop as in the photo) or an HF voltmeter (by entering directly on terminals E1 and E2) Its input impedance is relatively low: it can not be used directly on a high impedance RF circuit without disturbing the operation thereof.
As a basic HF voltmeter it can be used as a basis for a sensitive meter or a simplified field meter. Placed near a transmitting station with a small antenna it allows to constantly monitor the level of the transmitted signal and to show a possible anomaly.

Description

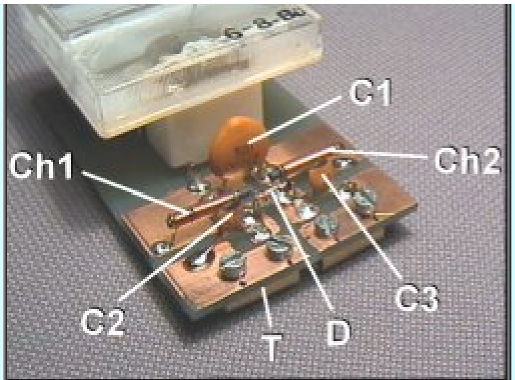


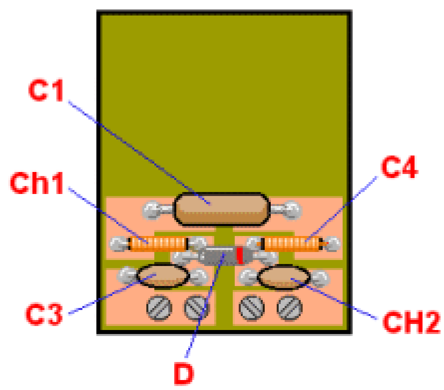
The signal to be measured is directly applied to terminals **E1** and **E2** . Capacitors **C2** and **C3** isolate the measuring circuit of the rectification circuit. The detection diode **D** is a germanium diode for better sensitivity but a silicon diode could also be suitable. The capacitor **C1** and the chokes **CH1** and **CH2** eliminate high frequency currents to keep only the DC component of the rectified signal. The sensitivity of galvanometer **G** depends on that of the complete apparatus. A model with 500µA, easy to find, is very sufficient. The dial does not need to be graduated since only relative measurements are taken to highlight the amplitude variations of the detected signal. To reduce the sensitivity it would be enough to add a resistance in series with G.

List of components

- 1 printed circuit board (thickness 2mm) of dimensions 65x40mm
- 1 capacitor C1 of 1 nF
- 2 capacitors C2 and C3 of 36pF
- 1 Germanium diode (type OA70)
- 2 chokes wound on ferrite rods.
- 1 galvanometer
- 2 domino contacts 4 or 6 mm²

Realization





For use with a Lecher line or as an aperiodic wavemeter the best is to fix all components on a rigid printed circuit board made of epoxy glass. A housing would be desirable for use outside but not essential. There are no settings and no frequency (since all frequencies are received simultaneously) and no sensitivity.
The connection of the probe input (loop, antenna ...) is made on two **E1** and **E2** terminals recovered on a domino electrician.

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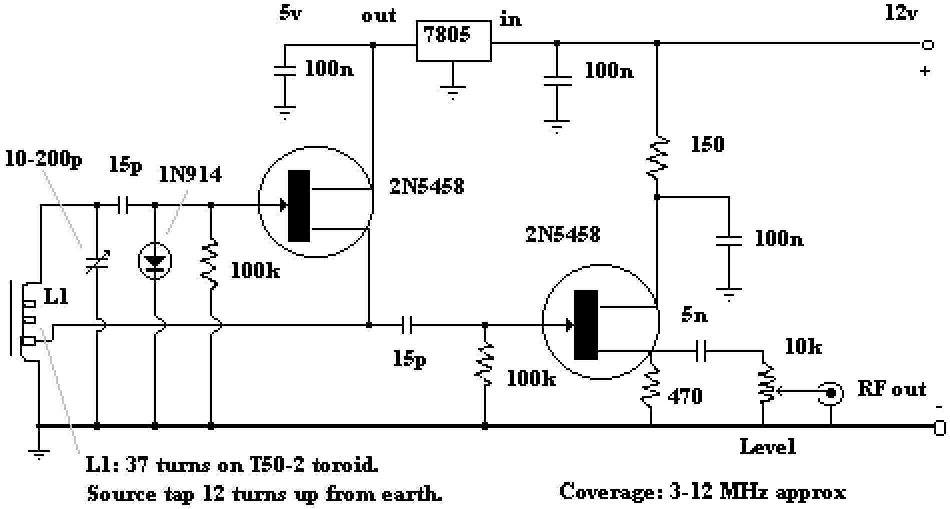
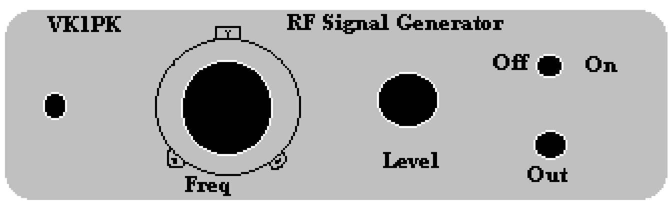
3 - 12 MHz HF signal generator

RF Signal Generator



Notes:

1. A vernier reduction drive is desirable.
2. Build signal generator in die cast aluminuim box for best stability.
3. Can work up to 148 MHz on harmonics if care is taken in construction.
4. Any construction method should work but ensure components are rigid.



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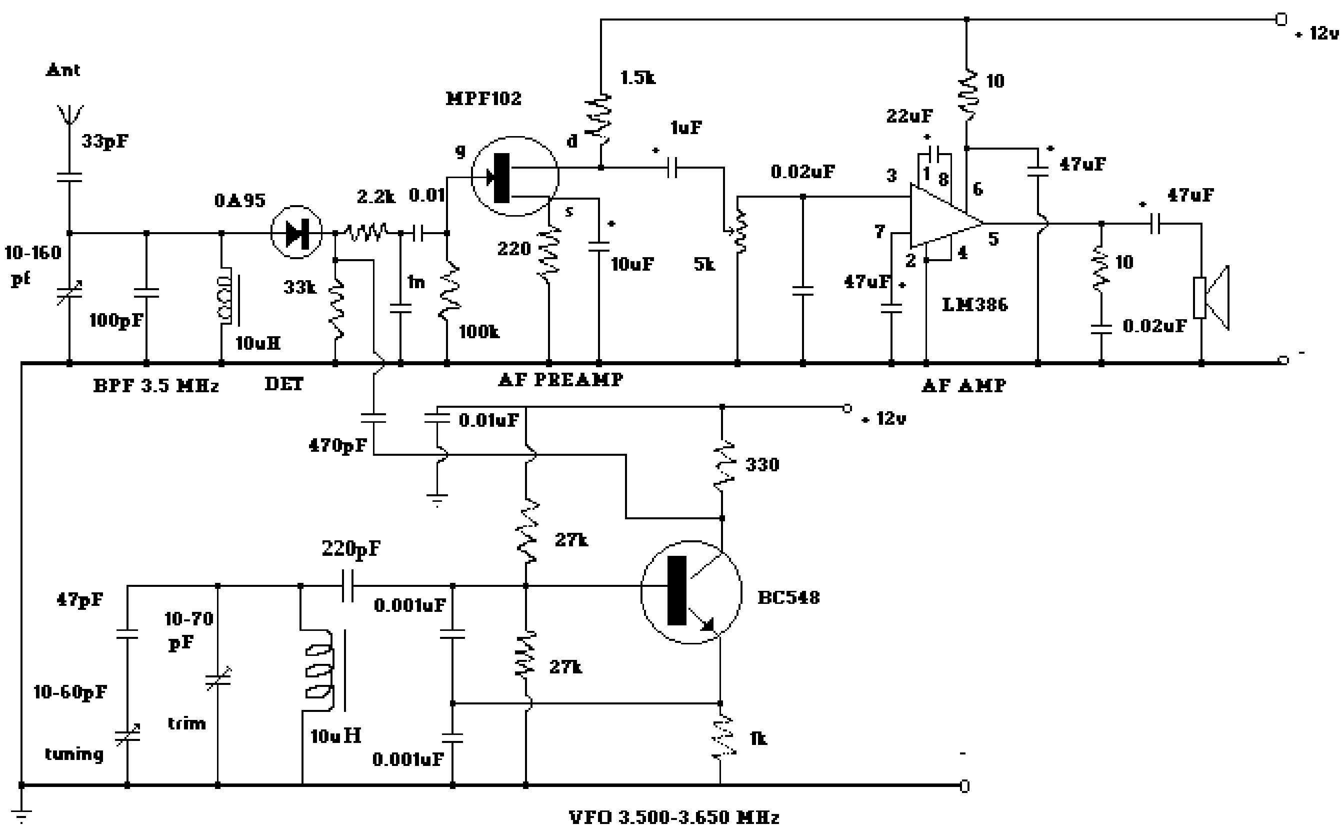
80 metre direct conversion receiver

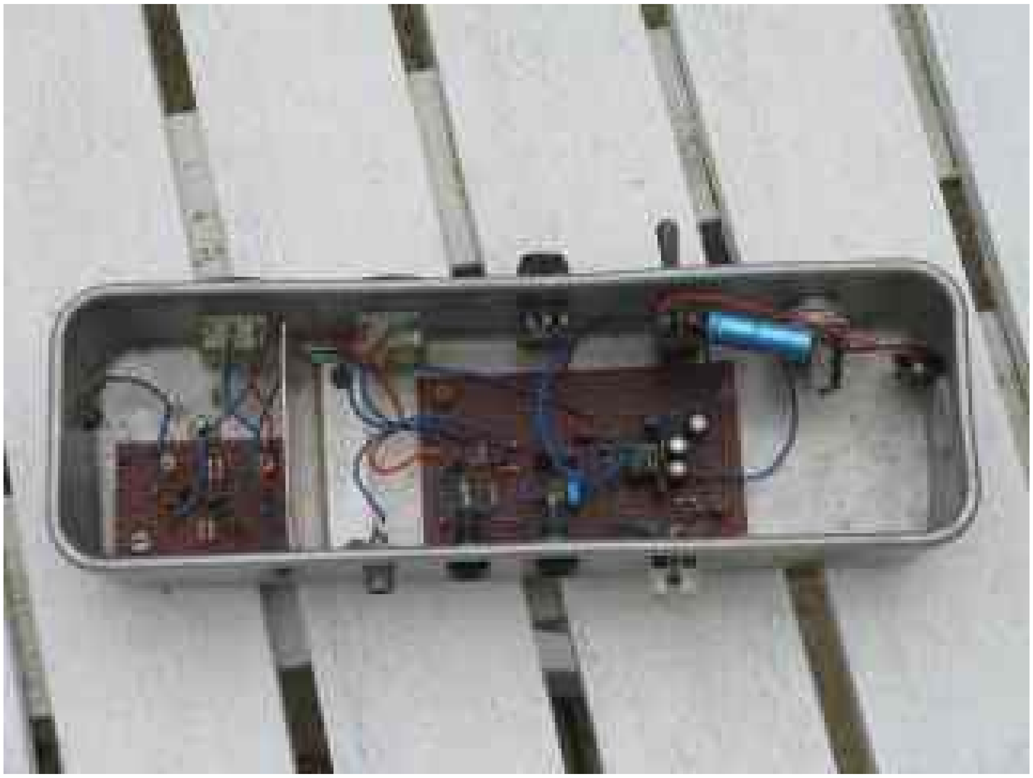
80 Metre Direct Conversion Receiver



Notes:

1. Build VFO in separate box for best stability.
2. Transistor radio variable capacitors were used in the prototype. Stability is acceptable with these.
3. The 10uH inductors are both commercially-made RF chokes.
4. A ceramic resonator oscillator (using a 3.58 MHz ceramic resonator) could be used instead of the free-running VFO shown.
5. If there are problems with carriers from 7 MHz broadcast stations, add an extra tuned circuit to the front end.
6. Almost any construction method can be used - the author used perforated matrix board.

See September 1995 Amateur Radio magazine for the full article.



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A guide to test equipment

It's boring, but necessary. That just about sums up many peoples' attitude towards test equipment. Though it might not get as much use as the station transceiver, it can be worth its weight in gold when something goes wrong and you need to fix it fast.

This article looks at items of test equipment most commonly found in the amateur shack. We describe each instrument, list its uses around the shack and point out features to look for when buying.

Multimeter

The multimeter is the fundamental item of test equipment that all amateurs should own. The cheaper multimeters (around $30) allow voltage, current and resistance measurement as well as transistor, diode and audible continuity testing. More expensive instruments may include features such as capacitance measurement, frequency counters, bargraphs, temperature ranges, computer connections and mains voltage ratings.

Practical uses for multimeters around the shack include:

* Testing antenna and power connections with continuity tester function.
* Verifying transceivers are being fed with the correct voltage.
* Checking polarity of power connections.
* Measuring the current drawn by station equipment.
* Making voltage and current checks when developing or troubleshooting circuits.

Digital meters are so cheap these days that no amateur need be without one. They are easy to use and fairly accurate. There is no need to estimate the indicated value when the meter needle is between two closely-spaced markings. The cheapest digital meters also have functions (eg transistor tester) that are missing from analogue meters of equivalent price.

The rarer analogue meters have advantages over digital for some purposes. Analogue movements are particularly good at displaying varying voltages, such as audio signals. Also, when aligning transmitters, the fact that youâ€™ve reached a peak (or dip) when making an adjustment is often more important than the actual value of the voltage (or current). An analogue movement is better at displaying such trends. Some of the better digital instruments have a bar graph function that combines the best features of both meters in one, but some users still prefer to keep the analogue meter handy.

Other features that amateurs should consider when buying a meter are: 20 amp DC current range (most HF transceivers draw up to 20 amps), audible continuity indicator (though missing from budget meters, itâ€™s very useful), capacitance, inductance and frequency measurements. The last functions may not work as well on the multimeter as on specialised instruments designed for a single task, but are still useful for much amateur work, especially when budgets are tight.

SWR/RF Power meters

SWR and power meters cover a wide span. The cheaper meters provide relative indication of the standing wave ratio (SWR) only and do not measure transmitted power. Slightly more advanced meters include RF power output and field strength indication as well. Most of these meters were designed for the 27 MHz CB market, but give

useful relative indications up to 148 MHz. At lower HF frequencies (around 3.5 MHz) the sensitivity of these meters falls off dramatically so they can be useless at low transmit powers.

The better meters, such as the Revex range, operate over a wider frequency range than the CB-type meters mentioned above. Their sensitivity is more uniform across the specified frequency range, which may be as much as 1.8 to 1300 MHz. Accuracy is also better, and the use of N-type connectors reduce losses and impedance variations at UHF.

Practical uses for SWR and power meters include:

* SWR measurements - These are almost mandatory for anyone who installs or constructs antenna systems and wishes to obtain the best performance from them, especially with modern equipment.
* RF power measurements - useful for testing transmitters or ensuring one is adhering to licensed power limits.
* Field strength measurements - useful for crude checks of handheld transceivers or antenna or feedline radiation. Measurements given are relative only. Not all SWR/power meters include this function, but a separate field strength meter is very easy to build.

The SWR/power meter runs a close second to the multimeter as the test equipment item of most use around the amateur shack. The SWR function is most important, as modern HF transceivers do not deliver their full output power if the SWR is high. For such tests, even a relative-reading meter is sufficient. Those who repair, align or construct transmitting equipment are advised to obtain one of the better quality meters with output power indication.

Dip oscillator

For many years the dip oscillator has been one of the main instruments used by the radio experimenter. People who experiment with antennas or build and align tuned circuits as used in HF transmitters and receivers will get most use from them. Applications for dip oscillators include:

* Testing tuned circuits in receivers and transmitters. A dip oscillator can give a reasonable indication of resonant frequency.
* Checking resonance of antennas such as mobile whips.
* Measuring unknown capacitors and inductors (especially handy for un-marked variable capacitors and inductors).
* An RF signal generator to provide test signals to align homebrew receivers or IF strips.
* As a crude beat frequency oscillator (BFO) to allow an AM receiver to tune SSB/CW signals.
* To monitor the quality of AM transmissions and listen for clicks on CW â€“ some dip oscillators have an earphone socket for this purpose.
* RF field strength meter for antenna, feedline and RF leakage tests (though the author prefers to use a separate instrument with antenna for this).

The dip oscillator does all this and more in one or two transistors. It consists of a wide range RF oscillator and a meter. When the dip oscillator's coil is brought close to a tuned circuit that is resonant at the oscillator's frequency, the meter needle dips. What is happening is that the tuned circuit being tested is sucking RF energy out of the dip oscillator's coil, thus causing the meter needle to dip towards zero. The resonant frequency of unknown tuned circuits can be determined by holding the dip oscillator coil close to it and tuning the oscillator until the meter current drops. The dip oscillatorâ€™s tuning control is normally calibrated in MHz to allow a direct reading of approximate resonant frequency.

Most dip oscillators (unlike the one pictured above) come in a long narrow case with plug-in coils on the end. This is so that they can be stuck deep into the innards of radio equipment. Commercially-made dip oscillators can be hard to find and quite expensive new. However they are very easy to build and require just one specialised component (dual gang variable capacitor â€“ common at hamfests). This makes them popular amateur construction projects.

Dip oscillators are not known for their accuracy and long-term frequency stability. The need to perform mathematical calculations is another drawback compared to direct-reading instruments. For a cheap and simple test instrument that can do lot, the dip oscillator still has merit, though they are more common second hand (eg at hamfests) than new.

Antenna analyser

In the last 10 or 20 years the antenna analyser has become popular, replacing both the dip oscillator and RF noise bridge. They are basically an all-in-one antenna test instrument. They include a wide range variable frequency oscillator, bridge circuit, and, in more advanced units, an LCD screen that lets you plot the characteristics of the antenna you are measuring, for instance an SWR curve and whether an antenna is purely resistive or exhibits some capacitive or inductive reactance. Serious

antenna builders and experimenters will almost certainly have an antenna analyser.

RF Signal Generator

RF signal generators provide a signal at a frequency set by the user. The best RF signal generators have good frequency coverage and stability, easy tuning (possibly via keypad as well as knob), in-built digital frequency readout, synthesised frequency generation and calibrated output levels. These come in 19-inch rack cabinets, and being intended for the professional, have price tags to match. For most amateur applications, however, cheaper hobbyist-type instruments will do the job quite nicely and come up at hamfests. Alternatively you could build or buy a direct digital synthesiser (DDS) and put it in a box with a battery and RF attenuator.

Like the dip oscillator, RF signal generators are versatile instruments. However the traditional type of instrument are becoming less common new. Instead consider a computer-controlled DDS unit which offers amazing frequency stability and accuracy for a fraction of the price of the old stand-alone units. Still, if you want to sweep across a large chunk of spectrum in a few seconds there's much to be said for the old style generator. Amateur uses for RF signal generators include:

* Test oscillators for receiver construction and alignment. The ability to directly inject signals (rather than rely on RF pickup) and control output levels makes signal generators ideal.
* Receiver converters. A signal generator can be a makeshift local oscillator when testing converters or mixer stages.
* Certain antenna tests, especially when it is not desired to cause interference to others by radiating a high power signal.
* A BFO for AM receivers when receiving CW/SSB signals. The ability to vary RF output level and easier tuning on the signal generator makes this technique superior to using a dip oscillator.
* A low power transmitter. People have had CW contacts merely by connecting a keyed signal generator to an antenna! However best results will be achieved if attention is paid to matters such as impedance matching to the antenna, quality of

keying, frequency stability and suppression of harmonics.

Oscilloscope

Leaving aside those lucky few with spectrum analysers, RF test sets and other exotic equipments with five figure price tags, the oscilloscope is the most advanced piece of test equipment that most of us can reasonably aspire to own. They were previously known as CROs - for 'cathode ray oscilloscope', though modern units now have LCD screens.

If you intend to experiment with receivers and build the odd transmitter, you can get by without an oscilloscope. You can certainly get a homebrew CW, AM, FM or DSB station on the air without an oscilloscope. However, if you wish to get the best performance and signal quality from homebrew or repaired equipment, one is the way to go. Amongst

other things, a CRO allows you to see waveforms from transmitters and oscillators. As you peak a tuned circuit, you can see the signal getting stronger. If you adjust a transmitter's power output setting too high, you may see the waveform depart from a smooth sine wave to one with odd troughs and bumps. If using an RF power meter, the needle might suddenly jerk up, but the signal still sounds good in the receiver. With an oscilloscope you see things you don't always hear on a receiver and, by moving the probe back from the output stage, you can identify the stages that are introducing distortion.

Although they have come down a lot in price, good oscilloscopes are more expensive than any other test equipment item described here. They might not be used often. However they are extremely valuable when used properly, and can provide a better insight into the actual operation of a circuit than any other instrument. For amateur purposes, maximum frequency that a CRO will go up to is important. The author's unit will go up to over 50 MHz - sufficient for most amateur work. Dual trace CROs are preferred. Cheaper oscilloscopes, such as smaller units, may only be good for audio frequencies.

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Other items

In addition to the test equipment items mentioned above, ownership of an HF communication receiver (preferably with a digital readout) would be an advantage. The general coverage receivers included in recent HF transceivers are fine, though a separate receiver is preferred if your workshop is some distance from the main station. For VHF/UHF experimenters, a tunable VHF/UHF receiver will also be desirable. Highly sought-after (and expensive) was the Icom R7000, though the much cheaper Uniden Bearcat UBC9000XLT scanner, though it lacks SSB and misses most UHF TV

channels, should be adequate for most. These are late 1980s-1990s receivers that still pop up on the second hand market. A wide-coverage software defined radio is another option that has become very cheap with USB dongles. A frequency counter is nice to have, but not essential if you already have a good receiver with accurate digital readout.

Conclusion

This month's column has looked at the items of test equipment that the amateur should own. If your interests are mainly operating, the first two items are only really necessary. However, if you'd like to keep your equipment in top operating order, wish to make repairs, modifications or build new projects, all of the items described above will be useful. Plans for simple test equipment to build appear elsewhere on this and other websites.

An earlier version of this article appeared in *Amateur Radio* August 2000 with updates made since.

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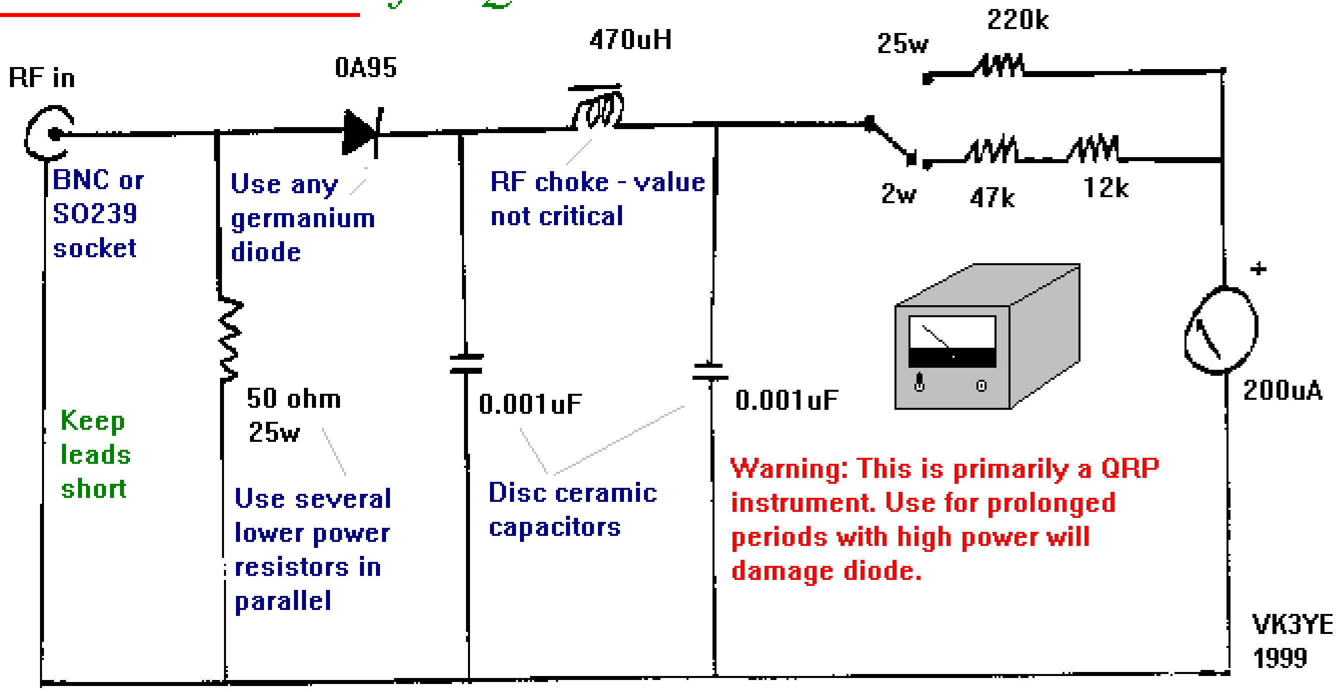
A QRP RF power meter

RF Power Meter *for QRPers*



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A simple crystal set for free power radio

Of any electronic project, the crystal set would have to rate as one of the most popular. Many amateurs are on the air today because of their early construction of a crystal set. Most practical electronic books for beginners include at least one crystal set project. Unfortunately, some of these circuits take simplicity too far and deliver mediocre performance, often by omitting key components such as the tuning capacitor, or failing to provide coil taps.

This article describes a crystal set of medium complexity. It features coil taps for the antenna and diode to make it useful for both country and metropolitan listeners. The taps allow the set to cover 160 metres if desired. All parts are easily obtainable, making it a good choice for the beginner. The endless possibilities for experimentation also make crystal sets interesting novelty projects for experienced constructors. The schematic is shown here:

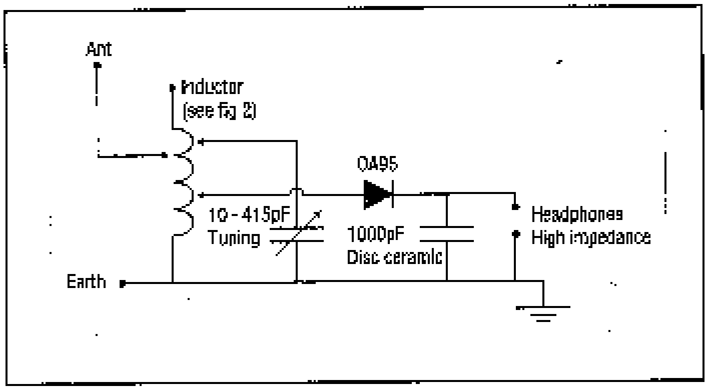

Figure One: Schematic diagram of crystal set

VK3YE Crystal Set

Schematic & Layout diagrams

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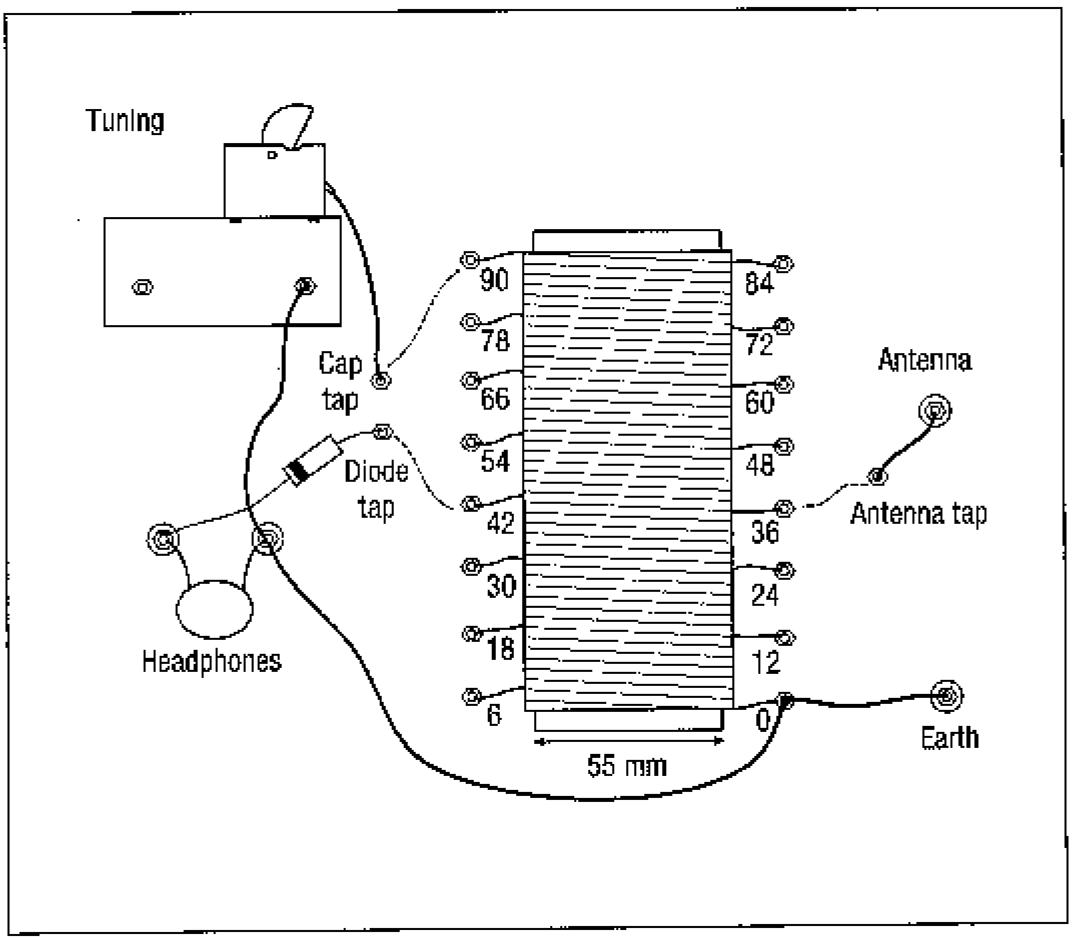


Figure Two: Rear view of front panel, showing coil details

(from Amateur Radio February 2001, page 20)

Obtaining the parts

Tuning capacitor

A large air-spaced type, covering about 10 to 415 picofarads is preferred. These capacitors were common in valve and early transistor radios and often appear at hamfests. Their long shafts make it easy to attach large tuning knobs. When purchasing one see that the shaft turns freely, but is not loose. Ensure that the plates are straight and do not touch when meshed - use a multimeter (preferably with audible continuity function) to test this. Avoid capacitors with 3/8 inch shafts unless nothing else is available â€“ knobs for these are not obtainable, and an old valve radio dial drum will need to be used instead.

If a large capacitor is unavailable, a small plastic dielectric unit is suitable (such as stocked by Jaycar and online). The lower maximum capacitance (160 pF) means that more coil turns are required to provide coverage of the lower end of the broadcast band. This can be partially overcome by connecting the 60 and 160 pF sections in parallel (link the 'A' and 'O' tabs). The main disadvantage of these capacitors is their short shafts, which makes it harder to attach most types of knobs.

Vernier Drive and dial

The use of a vernier reduction drive is not necessary. However, its inclusion makes tuning easier, particularly on the higher frequencies. These are rare new but sometimes come up at hamfests. If your drive lacks a dial, one can be fashioned from a plastic or metal disc, such as a jar lid or salvaged computer hard disc. Glue the dial directly to the skirt of the tuning knob if you lack a vernier drive.

Diode

This is the most easily obtainable and cheapest component in the project. A germanium diode, such as a 1N60, 0A90, 0A91, 0A95 or 1N34A will be suitable. The purists still make their own diode detector with a 'cats whisker' and lump of galena, but modern diodes provide more stable and repeatable performance.

Headphones

The very old high impedance headphones are required for this circuit. A minimum of two kilohms is suggested. Medium impedance headphones (approx 600 ohms) will also work, but are less sensitive.

High impedance headphones have become difficult to obtain. Alternatives include:

1. Old-style telephone earpiece. Quite sensitive. Found in the old Telecom corded phones.

2. Crystal earpiece. These are sensitive, easy to obtain and inexpensive. You may need to connect a 100k - 470k resistor in parallel for it to work properly.

3. Piezo transducer. Believe it or not, these actually will work as an earphone. Some sizes even fit snugly in the outer ear in a similar manner to modern earpieces, such as used with mobile phones. The main drawback with transducers is their peaky audio response. Â In some cases it may be necessary to wire a 100k - 470k ohm resistor across the earphone connections for correct operation.

4. 1k to 8 ohm audio transformer and standard low-impedance headphones. Works well, but not as sensitive as a crystal earpiece.

5. Cheating! Use a transistor or IC amplifier kit to run a speaker. This approach eliminates the 'free radio' advantage of the crystal set, but provides louder reception in weak signal areas and allows speaker listening.

Coil and Coil former

This needs to be a cylinder about 55 millimetres in diameter and 150 mm long. The length needs to be long enough to accommodate all ninety coil turns used, with enough left over for mounting to the front panel. Plastic pipe, shampoo container or similar will suffice. Though enamelled copper wire can be used for the winding, the prototype used thin plastic-covered stranded insulated wire.

Front panel

All parts are mounted on a 6mm-thick polyethylene chopping board, which forms the front panel. A hacksaw was used to cut the panel to fit inside the wooden case. Use the thinnest chopping board available so that the many screw-mounted sockets used can be fastened properly. The front panel pictured was cut to 240 mm square.

Case and handle

Use non-metallic material for the enclosure. The box used in the prototype was originally a speaker bought cheaply at a school fete. The lid (which held the speaker) was removed, and the rest of the box painted. The top carry handle is optional and came from a hardware store.

Construction

Commence construction once all components have been obtained. Plan how the parts will fit behind the front panel. The diagram and pictures above show the arrangement used in the prototype. The coil is fastened with stand-offs and the variable capacitor is screwed to an aluminium L-shaped bracket. 4mm binding posts with banana sockets are used for the antenna and headphone connections, and 2mm micro sockets for the coil tapping points.

Start by winding the coil. This consists of ninety turns of thin stranded insulated wire close wound on a plastic tube approximately 55 millimetres in diameter. A large number of tapping points are provided so that the user can vary the set's frequency coverage, and antenna and diode coupling. This makes it possible to obtain the best compromise between volume and selectivity for a particular station.

Figure Two shows the coil construction. Start from the earth end (identified as '0' in the diagram). Make two holes in the former to anchor the end of the wire. Wind six turns and then an extra half-turn. With a knife remove about 1cm of insulation, taking care not to cut the wire. Form the bare wire into a loop and lightly coat with solder. Do not apply excessive heat - the wire insulation easily melts. Wind another five and a half turns and make another tap. Repeat for the remainder of the coil until approximately ninety turns have been wound. Add more turns and taps if using a smaller variable capacitor than specified. Again make two small holes in the former to anchor the wire.

Place the completed coil aside and start work on the front panel. Mount the 4mm banana binding post terminals for the antenna, earth and headphones, as shown in Figure Two. Drill holes and mount the 2mm terminals for the coil taps and the antenna, diode, variable capacitor taps. The tuning capacitor can also be fastened at this time.

Two sets of screws and spacers can be used to mount the coil to the rear of the front panel. A 10mm separation between the coil and the panel is adequate. Solder in the various components and connecting wires as per Fig 2. Use insulated wire for the connections between the sockets and to the variable capacitor. Tinned copper wire can be used for the short links between the coil taps and the 2mm sockets. Use insulated wire for the three jumper leads. The jumpers should be sufficiently long to be able to make connections with all taps along the coil.

This completes the construction. The panel can now be inserted into the box. In the unit pictured, the front panel is recessed â€“ this protects the banana sockets and dial and makes the set more rugged. It also allows attachment of a hinged lid if required.

Parts List

* 10 â€“ 415 pF variable capacitor x1 (see text)

* 0.001 uF disc ceramic capacitor x1

* 1N60 germanium diode x1

* Vernier dial or drive x1 (optional)

* 2mm micro socket x19

* 2mm micro plug x6

* Banana socket (red) x2

* Banana socket (black) x2

* Insulated wire 20m

* Tinned copper or bell wire 1m

Other items: case and handle; polyethylene chopping board; Coil former â€“ 55mm dia, 150 mm long; screws, nuts, washers and spacers; mounting bracket for variable capacitor.

How it works

To receive signals, a radio circuit must perform three functions: selection, detection and reproduction.

The inductor and variable capacitor form a tuned circuit. The role of the tuned circuit is to select one of the many signals present at the antenna. The size of the inductor and capacitor determines the frequencies that can be tuned. The

capacitor is made variable to allow the full range of AM broadcast band frequencies (531 to 1602 kHz) to be received.

The diode detector converts the selected radio frequency signal to an electrical current varying at audio frequencies.

The headphones convert this audio frequency energy to sound. The principle is similar to a relay â€“ the signal cause current to flow in a winding that forms an electromagnet. The magnetism generated vibrates the metal diaphragm, thus creating sound. Crystal earpieces perform the same function, but rely on the piezo-electric effect.

Unlike in a conventional radio, which uses amplifying devices such as transistors and integrated circuits, crystal sets are powered by the signal from the incoming station, so no batteries is required. If provided with an efficient antenna and earth, crystal sets can receive signals thousands of kilometres away.

Antenna and earth

A crystal set requires a wire antenna to operate properly. The longer and higher it is the better. A length of at least 10 metres in urban areas, and 20 â€“ 30 metres elsewhere should provide reception in most cases. The antenna should always be installed away from power lines for safety reasons and to reduce interference pick-up. An existing amateur or TV antenna can also be effective, especially if the coaxial feedline is used as part of the antenna. This is achieved by connecting both the outside and the inside of the coaxial connector to the receiver's antenna terminal.

An earth provides stronger signals, and is essential in remote areas. In homes with copper water pipes, this can simply be a lead to the nearest cold water tap. In newer homes, where plastic pipes are used, an outside ground stake can be used instead.

For long distance reception (hundreds or thousands of kilometres) more than usual effort needs to be taken when installing the aerial and earth. Reference One suggests a length of about 100 metres and a height of at least 12 metres. A series of buried radials is suggested for the earth, rather than the water pipe suggested above.

Operation

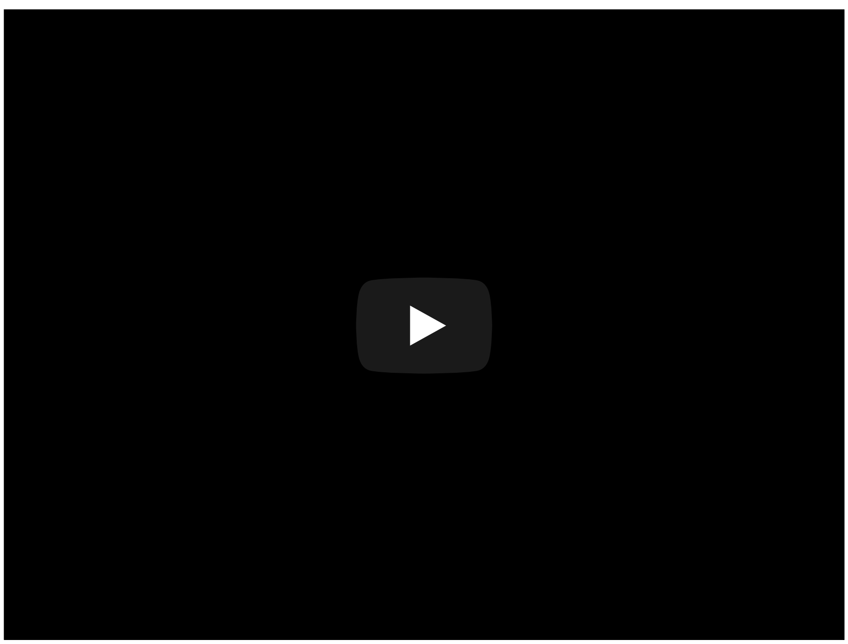
Connect antenna, earth and earphones. Install the three jumper leads. Set the capacitor tap to near the top of the coil (either the 78th or 90th turn) and the diode and antenna taps to approximately midway along the coil.

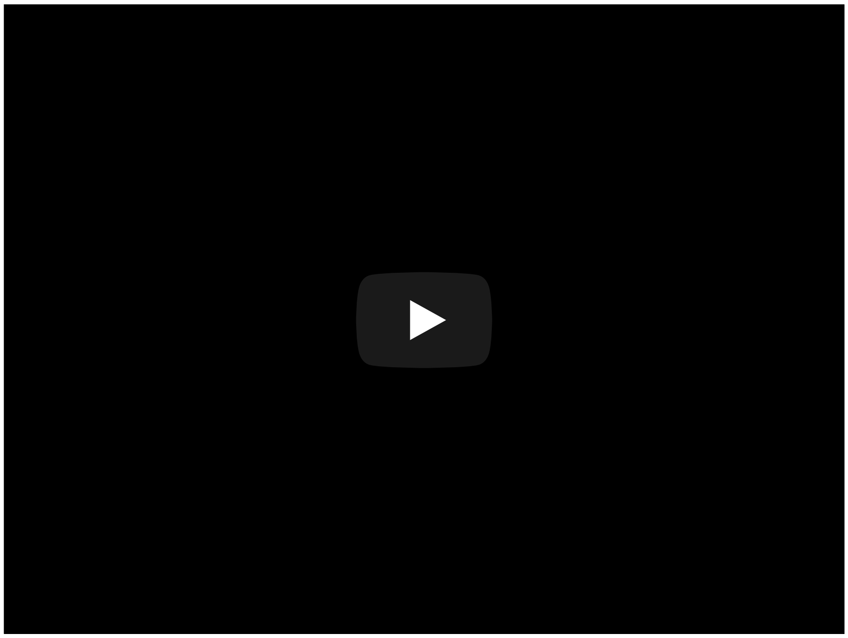
In a quiet room, adjust the tuning control and listen for a station. If several stations are audible, move the diode or antenna taps nearer the earth end (lower numbered turns) of the coil. This increases the set's selectivity and makes it possible to separate stations. In a capital city it should be possible to separate at least nine or ten stations. Optimum tap settings vary across the broadcast band â€“ lower frequency stations are often best received with higher tap settings. In rural areas volume is normally more important than selectivity, so the taps can be moved near the top of the coil.

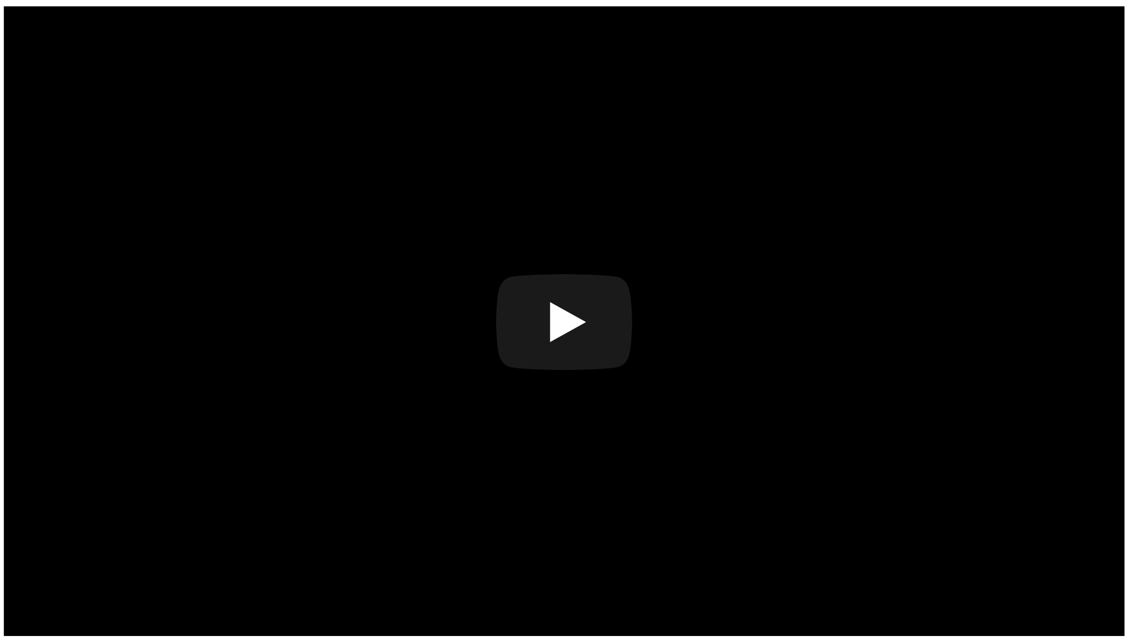
Reception of AM operators on the 1.8 MHz (160 metre) amateur band is possible by moving the capacitor tap lower down the coil, to the 54th or 66th turn. Performance will be well down on a superhet or regenerative receiver, and SSB signals cannot be resolved. Whether you hear amateurs or not depends on your antenna system and the extent of activity from nearby operators. Here in Melbourne 160 metre AM activity includes the Monday to Saturday AM morning net starting at 11am.

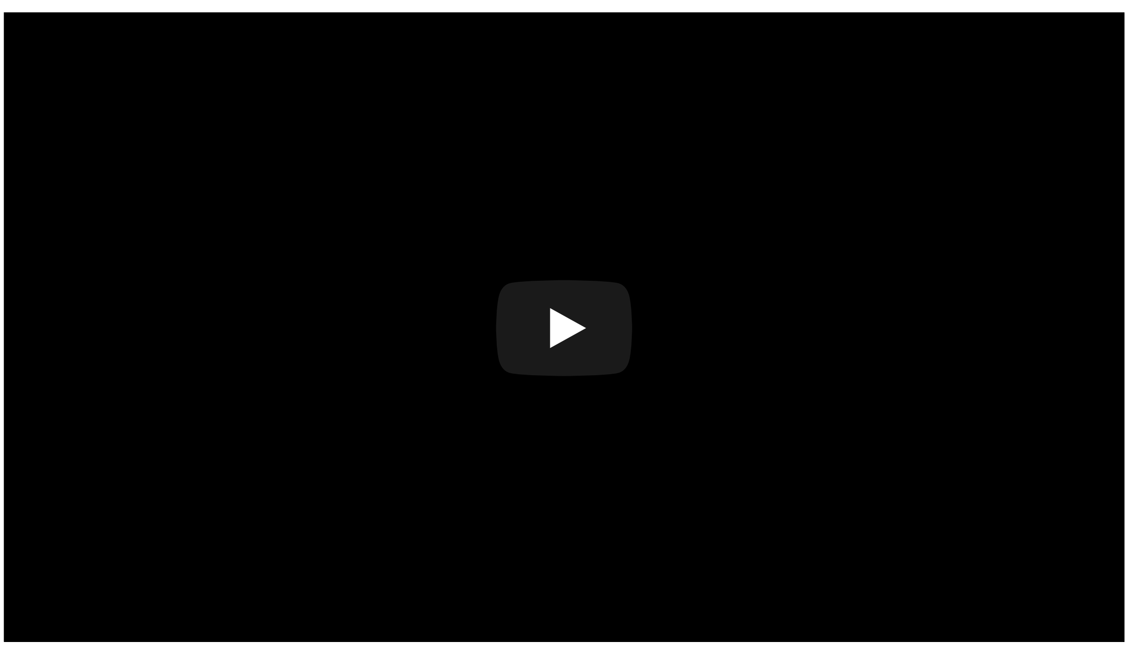
In many areas there are narrowcast stations between the top of the official AM broadcast band and 160 metres. Because of their low power these stations will be weaker than the mainstream broadcasters. However these stations are excellent tests of your receiver and antenna system.

Video demonstrations of this project









Conclusion

A crystal set of moderate complexity has been described. It is the minimum required to provide good reception of local stations in urban and rural areas. However numerous refinements to increase sensitivity, selectivity or audio output can be made. These include:

1. Double tuned circuits (with variable coupling between them) to improve selectivity

2. Use of a tuned trap to null out interfering signals

3. Attention to the construction of coils to provide the highest possible Q

4. Addition of an impedance matching network to provide efficient power transfer between the antenna and the tuned circuit

5. Use of a large loop antenna for the coil to allow reception of signals without an external antenna and nulling of unwanted signals

6. Voltage doubler diode detector circuit using two diodes to increase volume

7. Use of DC bias (from a DC voltage applied to the diode) or RF bias (from a locally generated RF signal on the receiving frequency) to improve sensitivity, or, in the case of the latter, to provide CW and SSB reception.

8. Use of a Q multiplier to increase sensitivity and allow CW and SSB reception.

Should you decide to experiment with these changes, it would be desirable to keep this set as a reference and build a second receiver as a test bed for the experiments.

Obtaining the parts

Suitable parts were discussed in detail above. Many if not all can be bought online, with examples presented below.

Variable capacitor and knob

Inductor (insulated wire and cylinder former only required only for this project - other crystal sets use ferrite rods)

Other parts and further reading

Disclosure: I receive a small commission from items purchased through links on this site.
Items were chosen for likely usefulness and a satisfaction rating of 4/5 or better.

Note: This item is an updated version of an article that first appeared in *Amateur Radio*, December 2000.

Books by VK3YE

Return to VK3YE amateur radio projects

A two-way Morse practice set

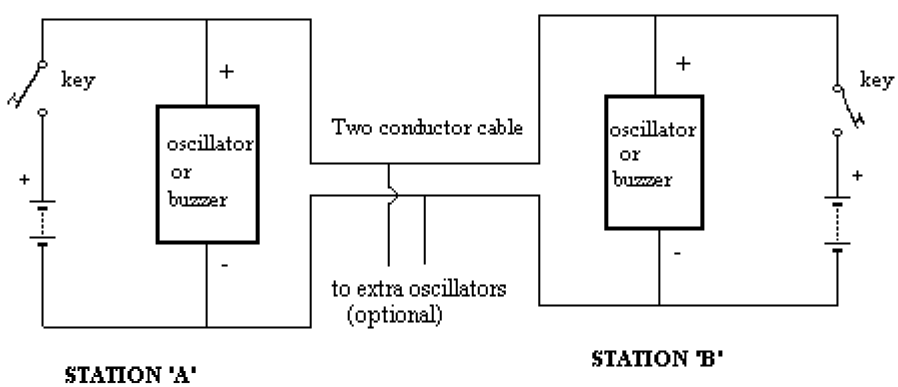
The first step to learning Morse is to be able to memorise the sounds of all letters and numbers. This can be accomplished with the help of Morse practice tapes or classes. Once you know all the characters, the WIA Morse practice broadcasts and/or continuous VHF Morse beacons can be used to increase your receiving speed.

Additional practice is best obtained by having Morse (CW) contacts on the HF bands. However, many use shyness as an excuse to not use Morse on the air. Others are restricted by their licence grade to VHF/UHF operation and/or may not possess HF equipment. For such people, this Morse practice set is the next best thing to actual CW operating because it allows you to have two-way Morse 'contacts' with a person in another room or even an adjoining property. The advantage of this sort of practice is that one learns operating skills and procedure as well as sending technique.

How it works

The system consists of a pair of Morse practice oscillators connected by a piece of two-conductor cable (Figure One). Pressing the key on one unit produces a sound in both units. The receiving station can interrupt the sending station at any time by pressing their key. This is just like the "break-in" CW facility provided in most modern HF transceivers and makes this project particularly suitable for already licensed amateurs wishing to brush up their operating technique for a forthcoming DXpedition or contest. No originality is claimed for the idea, which is described in Reference One.

Though two stations are shown here, additional sets can easily be wired in parallel. Such multi-station operation has a number of advantages. For example, it could allow a small class to have DX or net-style 'contacts' - thus simulating multi-operator or competitive operation. In such a situation, the classes' trainer could pretend to be a rare DX station calling CQ and students could compete with one another to make the first 'contact'.



Two-way Morse Practice Set - Block Diagram

(C) VK1PK 1998

The oscillator/buzzer

You will notice that the block diagram specifies that either an oscillator or buzzer could be used as the sound making device. A system using buzzers is cheap and simple (buzzers being available off the shelf), but transistor oscillators produce a nicer sound and cope better with faster speeds.

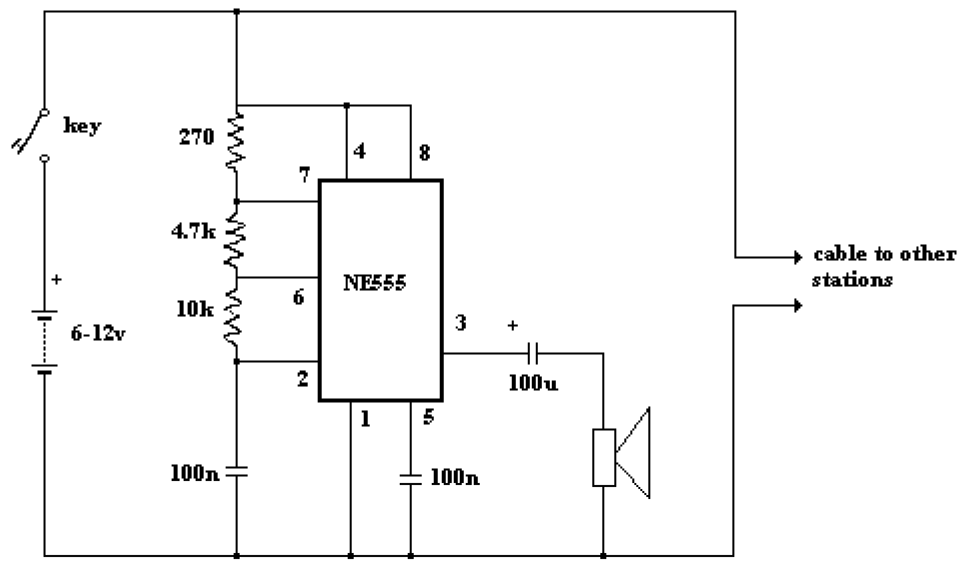
Transistor oscillators are commercially available in kit form (see later) or can be built from scratch. The kit is perhaps best if you have to buy all parts new. However, those with deep junk boxes would save by using available components instead. The remainder of this article provides details of an oscillator that you can build at home. Even if you have to buy the Morse keys new, a two-station set should cost between thirty and forty dollars to duplicate.

Construction

Below is the circuit used in the prototype. Two 'stations' are shown, though more can be added if required. The oscillator in each station uses a standard 555 timer chip. As is apparent from the photograph, each oscillator is built on a piece of matrix board about 30-40 mm square. Vero-type strip board could be used instead, but component placement will be more difficult because of the need to solder components to the right tracks. The 0.1 uF capacitors are polyester or disc ceramic, while the 100 uF capacitors can be a tantalum or electrolytic. If you are on a tight budget, the speaker, battery snap and (possibly) some resistors and capacitors can be salvaged from a broken transistor radio - component values are not particularly critical.

A speaker of any size can be used. For economy and compactness, a size of 38 to 76 mm is recommended. You may care to add a headphone socket if you intend to use the oscillator to practice while not disturbing others. A socket with an in-built switch to silence the speaker when the headphones are plugged in is recommended.

Each station needs between 6 and 12 volts to operate. Nine volt batteries were used in the prototype. However, if you intend to use the set a lot, a bank of AA, C or D-sized cells in a battery holder will provide more economical operation. Because all units are 'master stations' with their own batteries, each unit can double as a stand-alone code practice oscillator when solitary practice is required. If this feature is desired, use two-conductor plugs and sockets (3.5 mm mono connectors are ideal) to allow the connecting cable to be easily disconnected.



Note: The circuit for only one station is shown. Each station is identical to the diagram above (including battery and key). Observe polarities when connecting stations together.

Two-way Morse Practice Set - Schematic Diagram

(C) VK1PK 1998

Testing and operation

Check all oscillators individually before connecting them together. Pressing the key should produce a tone that is pleasant to listen to and of sufficient loudness. Vary the 10k and 270 ohm resistors to set pitch and volume respectively.

Once satisfied with the performance of each station as a stand-alone unit, wire all units together with two-conductor cable. As it is carrying only DC, the cable need not be shielded. The thin type used for wiring up hi-fi speakers is ideal.

Keying one station should activate all oscillators. If not, check that the polarity of the wires to each station is correct. Use enough wire to separate the stations far enough so that the operators can neither see nor hear one another, so that Morse becomes the sole medium of communication.

The system as presented here is fairly basic. However, various 'bells and whistles' can be added to make operating more comfortable, or more like real live CW operation.

For example, many operators become fatigued when subject to a tone of uniform pitch for long periods. Replacing the 10k resistor with a variable resistor (say 20 to 50k) allows the pitch of each oscillator to be set to the operator's taste.

To make practice sessions more like on-air operating, many things could be done. For example, a resistor in series with a station's key would reduce the loudness of that person's 'signal' in the other people's stations, thus simulating low power (QRP) transmission. If a means could be found to vary supply voltage to each station automatically (say from 4 to 12 volts), over a period of several minutes, signal fading (QSB) would be the result. These effects would of course be made even more realistic by using an audio mixer to introduce real interference (either man-made or natural) from either a continuous loop tape player, digital voice recorder or HF receiver. These embellishments are not necessary for the casual learner, but could be useful to test an operator's ability to pass messages under adverse receiving conditions.

The above ideas have not been tried by the author, but are merely proffered as examples of how a very simple project such as this can become as elaborate as the builder desires.

A note about keys and kits

While Morse can be sent on an improvised key made from a hacksaw blade or piece of tinplate, it is better to use a proper key. Keys can either be bought new or second hand. Dick Smith Electronics is getting out of kits, but you may still find a Funway 2 code practice oscillator, which includes a key (K-2623). Keys also show up at radio junk sales and hamfests.

Reference

1. Williams N, Rowe J *Basic Electronics* Sungravure 1979, p85

This article appeared in *Amateur Radio* April 1998 with only minor updates since.

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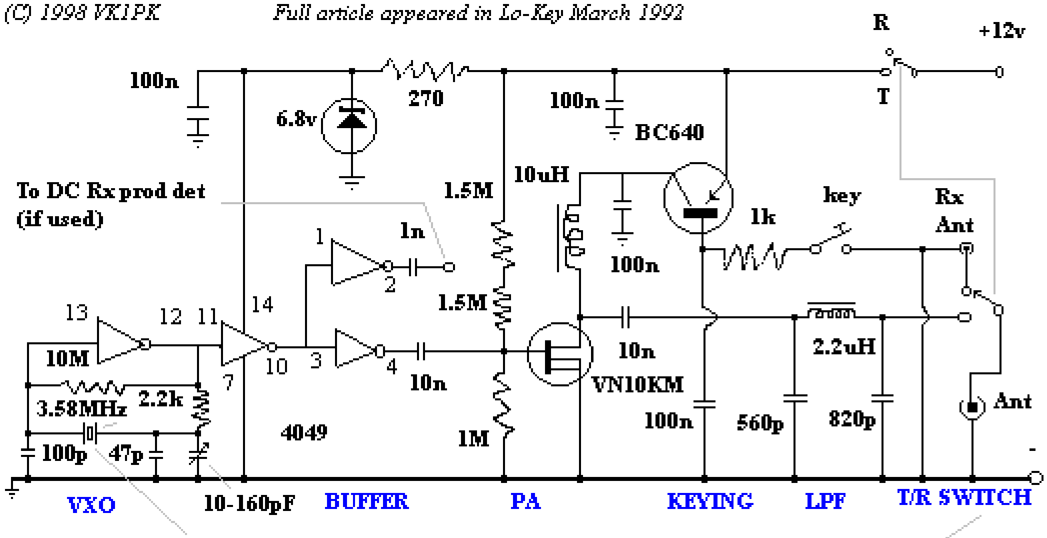
[Return to VK3YE amateur radio projects]

Frequency agile 80 metre CW QRP transmitter

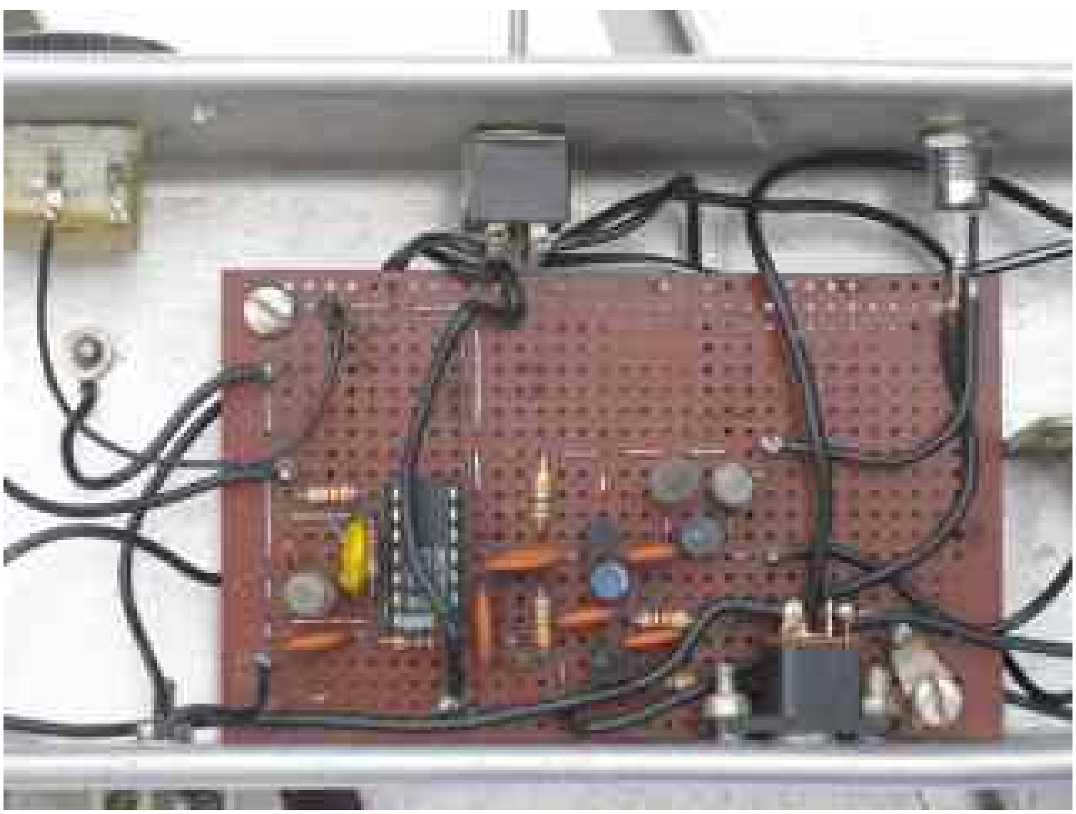
80 Metre Ceramic Resonator VXO CW Transmitter

(C) 1998 VK1PK *Full article appeared in Lo-Key March 1992*



Notes:

1. Ceramic resonators vary in the frequency shift obtainable. The one in the prototype gave 3.525-3.558 MHz coverage. For coverage of higher frequencies (up to 3.580 MHz) remove 47pF capacitor. For coverage of lower frequencies, wire an inductor in series with the variable capacitor. In the prototype 8.2uH gave a 3.518-3.557 MHz range. However, some ceramic resonators may not need any inductor to reach 3.500 MHz. Also experiment with the variable capacitor values - a smaller value may give a more linear tuning range and better band spread, but a higher value will allow better coverage of lower frequencies.
2. A two gang 60/160pF AM transistor radio tuning capacitor was used in the prototype. Only the 160pF gang was used. Despite the capacitor being solid dielectric type, frequency drift was only 200 Hz in 30 minutes. No vernier drive was used in the prototype.
3. RF power output should be between 1 and 2 watts. Power output can be adjusted by changing the 3 M resistance. Lower values mean more power, but may damage the PA FET.



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Homebrewing for the novice

A longing to build a small transmitter, receiver or piece of test equipment is commonly expressed by many amateurs. All too often, however, the longing remains merely that, due to perceived difficulties in obtaining components, a lack of test equipment, or not having a suitable circuit diagram. Yet, these difficulties can be overcome, and the satisfaction of successfully completing a project is immense. This article aims to answer a few of the questions aspiring homebrewers ask, with some video demonstrations at the end.

Selecting a project

The first step is to determine what you want out of a project that you are considering starting. Is the device being built for the experience and pleasure that its construction provides, or is it to test a particular circuit technique or component? Maybe the project is because commercially made equivalents are unavailable. Alternatively, it could purely be the satisfaction of working the world with a transmitter you built yourself, or of making

measurements with test equipment that would be unaffordable if purchased commercially.

Whatever the reason for building, it is important that the features you want are defined, so that a design can be selected to suit your needs. It may happen that you find a description of a project with all the wanted features, and, furthermore, all parts for it are obtainable. A kit for it could even be available. Otherwise, the constructor may prefer to borrow

stages from a range of circuits, ending up with a unique device that meets all requirements. This particularly becomes the case for the more experienced experimenter who seldom builds exactly to published designs.

For the beginner though, it is preferable to work from the one design, and not from parts of several. The decision as to which one depends on available components, features provided, the completeness of the project article, along with complexity and cost considerations. For tried, tested but simple HF transceiver designs, I suggest starting with a ZL2BMI rig (for double sideband) or a BitX (for single sideband). A demonstration of a BitX on 40 metres can be watched below.

Sources of information

Homebrewers normally have a wealth of material on which to base projects. This is obtainable from:-

* **Books.** There are many publications available to the amateur experimenter. As well as the conventional RSGB and ARRL handbooks, more specialised references cover practical aspects in greater detail. Titles to look out for (whether new or second-hand) include 'Experimental Methods for RF Design', 'Solid State Design for the Radio Amateur', 'QRP Notebook', 'Technical Topics Scrapbook', 'G-QRP Club Circuit Handbook', and 'Radio Projects for the Amateur', to name a few.

* **Magazines.** In addition to projects in the major amateur periodicals, such as QST, QEX, Practical Wireless, RadCom and Amateur Radio, there occasionally appear radio projects in general electronics magazines such as 'Silicon Chip'. Some of these designs have the advantage of a kit being available. However, be wary when considering some ultra-simple projects; for example a crystal-locked 100 milliwatt 80 metre AM transmitter is simple and cheap, and may well produce a clean signal on an oscilloscope, but is likely to disappoint when used on air under modern band conditions.

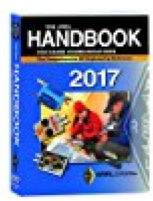
As well as being stocked by the larger newsagents, various local and overseas magazines are carried by public, TAFE and university libraries. These normally provide photocopying facilities, available on a cents per page basis.

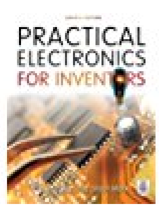
In addition, QRP (low power) enthusiasts have their own publications. Probably the best known is 'Sprat', published by the G-QRP Club, renowned for its technical articles and circuit ideas. The US-based QRP Amateur Radio Club International issues 'QRP Quarterly', while the Australian-based VK QRP Club produces 'Lo-Key'. These magazines widely read by those interested in constructing low-powered transmitters and receivers.

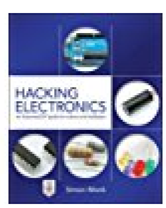
*** The Internet, including websites, email lists, discussion forums and YouTube.** The greatest ever source of homebrew information, allowing you to tap the collective wisdom of thousands of experimenters around the world. If you have a particular question, want to know how to obtain a part, or simply want to share your experiences with a particular component or circuit design, there'll be a website, online forum or email list to assist.

Discussion takes place on the homebrew or technical sections on the eHam and QRZ forums. These have a search function and you can find material posted several years ago. As well there are homebrew amateur radio pages on Facebook. As they say, 'Google is your friend' if you want to find out about anything, and numerous YouTube videos demonstrate numerous aspects of home construction.

Overall I suggest a mix of information. A few of the major books (eg *Experimental Methods for RF Design*), subscriptions to some magazines (the QRP ones have particularly low membership fees) and liberal use of the web and email.







Tools and test equipment required

To complete most projects, only basic hand tools will be required. You will also need some items of electronic test equipment. The more useful items are listed below. If starting out I'd suggest obtaining most items in the **Tools** list and only some items in the **Electronic/radio test equipment** list.

*** Tools**

- Flat and Phillips head screwdrivers - varying sizes
- Long nose and flat pliers
- Wire cutters
- Hobby knife
- Hand drill and drill bits (from 2 to 8mm)
- Tapered reamer
- Hacksaw
- Hammer
- Mitre box
- Set square
- Metal ruler
- Tape measure
- 15 - 40w soldering iron or soldering station with suitably fine tip
- Bright work light
- Magnifying glass (may be on stand)
- 'Helping hands' circuit board holder
- Boxes or tubs for parts storage

*** Electronic/radio test equipment and accessories**

- Multimeter with transistor tester
- Inductance and capacitance meter (preferably accurate at low values ie uH and pF)
- Audio signal tracer (can be LM386 or similar audio amplifier)
- General coverage HF receiver (included in most HF transceivers)
- Frequency counter up to 1GHz (or you could use an SDR dongle receiver)
- RF power and SWR meter
- RF probe (can fit on to multimeter)
- RF absorption wavemeter or field strength meter

(with analogue movement)
- RF milliwattmeter
- RF signal generator (can be made from DDS VFO module or use own transceiver)
- RF attenuator (can be made from resistors and switches)
- Low noise regulated power supply (12 - 14v up to 2 amps approx for most projects)
- Audio spectrum analyser (can be a cheap mobile phone app eg Frequensee for Android)
- Dip oscillator or antenna analyser
- Oscilloscope

Parts to start with

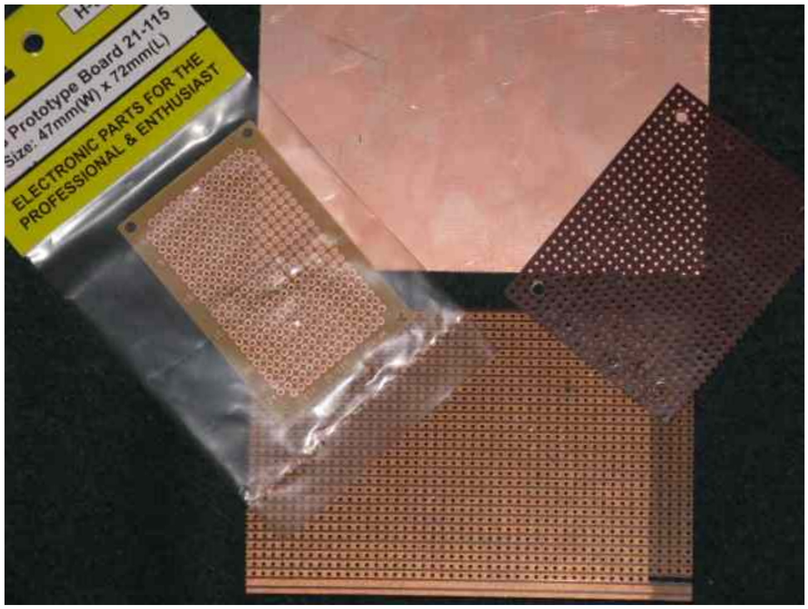
As well as basic tools from the list above it's worth getting some basic components that you'll never have too many of. This lets you build a wide range of projects without having to visit the parts store or wait for an online order to arrive. Some recommendations on what to get are at [Parts needed for electronics and radio construction].

Circuit construction methods

While the through-hole printed curcuit board was almost universally used for manufactured electronic equipment (though it is now being replaced by surface mount technology) and kits, there is no reason for the home constructor to use this form of construction for their projects. While conventional circuit boards look neater than some other techniques, they suffer from the disadvantage of requiring a new board to be etched if substantial modifications to the project are desired. Further time is wasted if these do not perform as envisaged. Thus, unless you know the circuit is reliable, it is worthwhile to consider alternatives to the conventional PC boards, particularly if your project uses only discrete components.

One such alternative is to use an etched printed circuit board, but solder components onto the

copper side of the board. This obviates the need to drill holes, and makes it easier to make changes. If no ICs are used, there is no need to use chemical resist pens or photographic methods to produce a board; the use of small pieces of adhesive tape placed on the parts of the board where you want the copper to remain will suffice for smaller projects.



The 'paddyboard' form of construction, popularised by Drew Diamond, VK3XU is also suited to smaller projects for which the ultimate in small size is not required. While, like the above methods, it uses PC board material, paddyboard requires no etching; component leads not connected to the copper surface are soldered to small 5x5 mm square insulated pads, made from spare PC board material. These pads may be glued or soldered to the main board. It is very easy to add extra components and even modify circuit layout. Again, paddyboard is most suited to circuits not containing ICs, though this limitation can be overcome if ICs are mounted on small pieces of vero or matrix boards beforehand. The use of high-value resistors (several megohm) as standoff insulators, soldered to the main board is another approach that has worked well. All of the construction methods mentioned so far are suitable for audio, HF, VHF, and perhaps UHF projects.

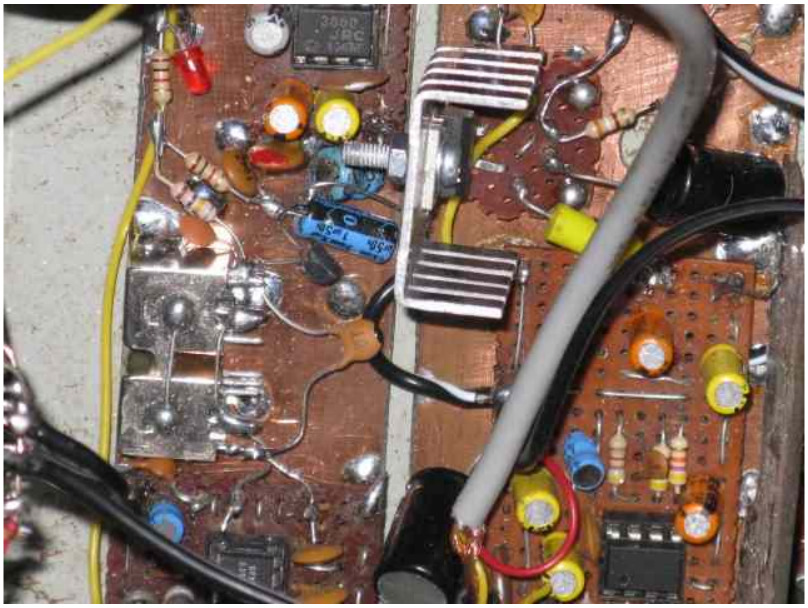
If compact construction is required, but the constructor is unwilling to use a conventional PC

board, matrix board is a good alternative. Having holes punched every 2.5mm, IC projects can be quickly assemled. Matrix board has worked well for RF projects well into the VHF region, and is stocked by the normal parts suppliers. A refinement of matrix board is veroboard. This is matrix board with a series of parallel copper strips, which can be cut as required by using a drill bit held in the hand. While suitable for power supply and audio projects, the capacitances between the long parallel strips may impair the performance of RF projects. Veroboard can be made into matrix board simply by immersing it in a bath of PCB etchant solution.

Approach to construction and troubleshooting

Once all components to build a particular project have been gathered, and a construction method has been decided upon, the project can now be assembled. If a simple project, or a well-known design, the entire board can be assembled in the one sitting. Otherwise, if the project is an unfamiliar circuit, or has various stages derived from several sources, it is preferable to build, test, and experiment one stage at a time, before moving on. For this type of construction, where the developmental prototype becomes the final model (possibly after several changes), one can easily see that an adaptable construction method, such as 'Paddyboard' or the use of matrix board is preferable to a PC board, where significant changes require a new board to be etched.

For a large project, such as a large receiver or transceiver, it is desirable that, rather than mounting the entire circuitry on one large board, several smaller boards be used instead. This modular approach to construction permits the project to be an evolving piece of equipment, with additions able to be made as time, inclination and funds permit. This method is also compatible with the 'build and test' approach recommended previously and the desirability of having RF-sensitive stages shielded from one another.

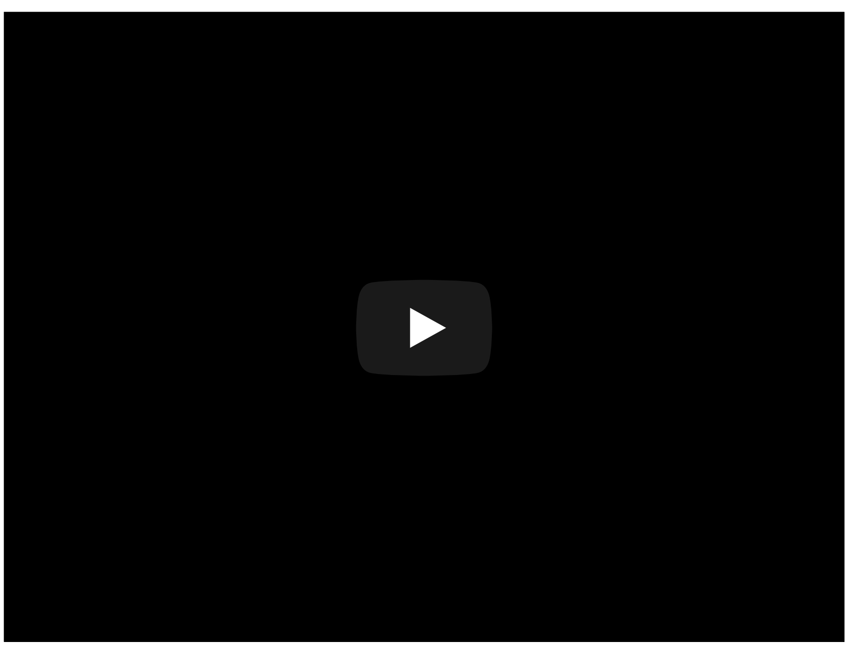


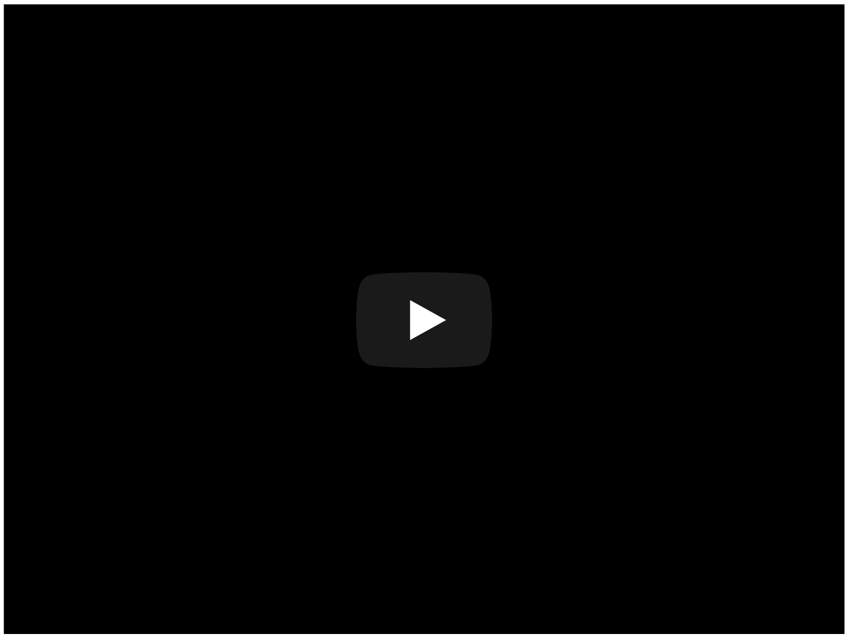
If the project involves RF (especially if it is a transmitter or power amplifier), the box housing it should be shielded. This does not neccesarily mean a conventional metal case is required; boxes made from printed circuit board material is also effective.

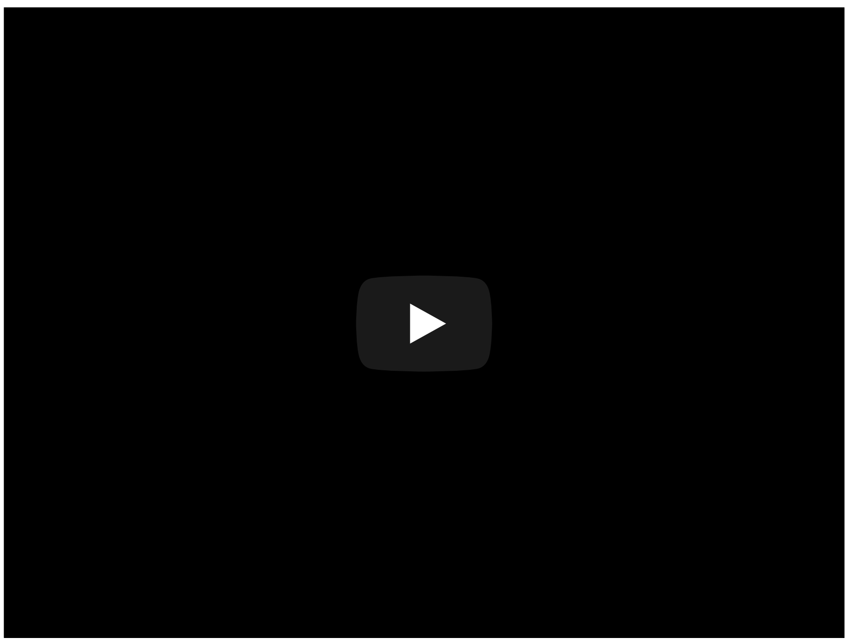
The most important aid to trouble-shooting is an ability to think logically. The posession of most of the test equipment mentioned above, plus a schematic diagram of the circuit under test are also desirable. Generally, with trouble-shooting, one checks the overall equipment, by identifying which functions do and do not work, and then attempts to isolate the area of the fault.

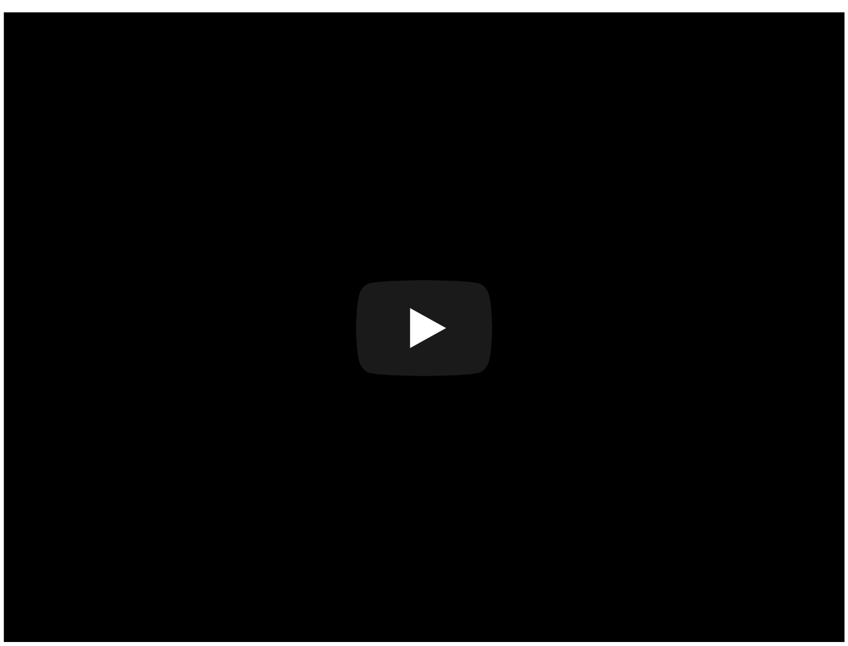
In the case of home built equipment under development, it is often not so much a fault, but a performance deficiency that needs to be remedied. This may simply entail the use of a slightly different circuit value for a particular component, or may require the redesign of a whole stage to perform to the specifications required; hence the earlier emphasis on flexible construction methods.

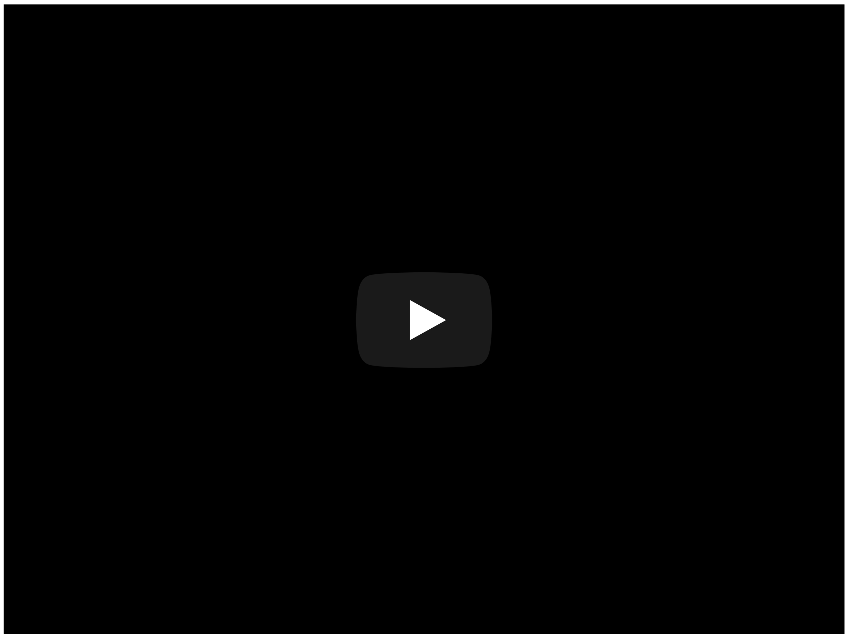
Videos of homebrew radio projects (some with circuits)











Safety

It is not out of place here to discuss electrical safety. The construction of equipment containing high voltages require a change to one's working habits, to minimise the risk of electrocution. The following list, while not exhaustive, shows examples of precautions that should be always taken:-

* Do not work on live equipment (switching off is not sufficient - unplug it from the wall)
* Discharge electrolytic capacitors before working on a project
* Insulate exposed high voltage points in equipment where possible
* The current ratings of fuses should be related to the expected current consumption of the project, and not to the contents of your junkbox
* Check wiring after construction (preferably by someone other than yourself)
* Use proper plugs for power connections
* Work with one hand behind your back if you must operate on live equipment
* Keep half-built projects and chassis locked away from children
* Electrical safety is covered in some of the references mentioned above. In the meantime, it is wise to steer clear from high voltage projects if you have the slightest doubts about your ability to safely construct them.

Conclusion

While the impression may be conveyed that constructing equipment is an activity calling for a high degree of specialised knowledge, and that it is all too hard for the average amateur, nothing can be further from the truth. By starting with simple one and two transistor projects and commercially available kits, one's knowledge will steadily increase to a point where more complex projects can be confidently tackled. By this time, you will be able to construct an item merely from a schematic diagram, and start to develop one's own designs from sections of circuits gleaned from various publications. Additional information is available from the books linked to above or at Electronics on the Floor: Videos on basic electronics and construction.

An earlier version of this article appeared in *Amateur Radio* April 1996 with updates made since.

[Return to VK3YE amateur radio projects]

Regenerative receiver for the AM broadcast band

What can be assembled in a day, doesn't cost very much, but will give hours of enjoyment? The answer is this two transistor receiver that anyone can build. It doesn't need an antenna, gives speaker reception of local AM broadcast stations and also receives amateurs talking on the 160 metre band.

The performance of this little receiver surpasses most modern AM broadcast sets - you'll be able to hear interstate stations that the others miss.

How is this possible with so few parts? The secret lies in the use of regeneration or positive feedback. By feeding an amplifier's output back to its input, it is possible to increase the amplifier's gain. Howeve, the amount of feedback needs to be carefully controlled; to prevent the amplifier from oscillating.

Regenerative sets were replaced by superhets in the 1930s because with superhets users did not have to adjust the amount of feedback (regeneration) when they changed stations. However, in the hands of a skilled user, regenerative receivers can perform as well as

more complicated superhets. An added benefit of home built sets is that constructors can use better quality components (such as air-spaced tuning capacitors, vernier dials and efficient ferrite loopsticks) that are missing on the average pocket tranny, which is designed for local reception only.

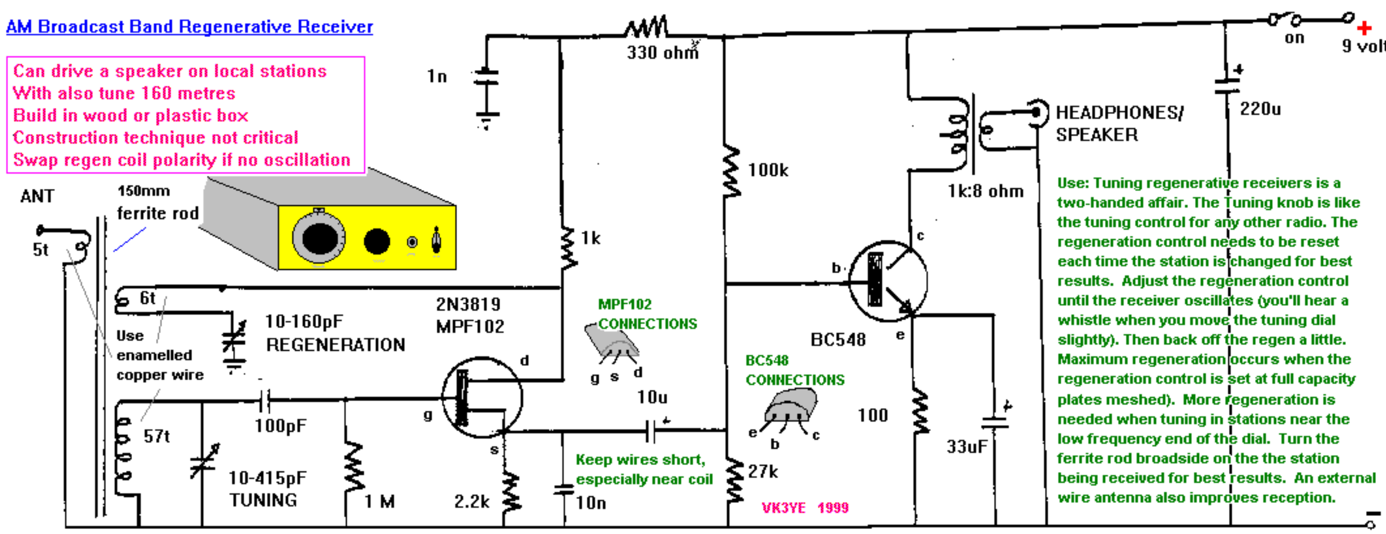
Circuit Description

The receiver, dubbed 'The Moorabbin', is a two transistor regenerative receiver of conventional design. Most parts are mounted on a printed circuit board that you get to make yourself.

The regenerative detector uses a field effect transistor (FET). Like with the better valve designs, feedback is controlled by a variable capacitor. A ferrite rod was used to allow reception of local stations without an external antenna.

This FET stage forms a complete receiver on its own, but the audio output is quite low. The received audio is amplified by an NPN bipolar transistor. The gain of this transistor amplifier is sufficient to provide speaker reception of local stations in most areas. The 1k to 8 ohm transformer in the collector allows the set to be used with both low and high impedance headphones.

Figure One: Circuit diagram



Obtaining parts

The aim of this project was to develop a simple receiver that could be built with readily obtainable parts. With the partial exception of the main tuning capacitor, this has been achieved.

Variable capacitor

A 10 to 415 pF variable capacitor was used as the main tuning capacitor. These are found in valve radios and early transistor sets. They are rare new but are still common at

hamfests. Their wide tuning range make it possible to cover the AM broadcast band and 160 metres without having to sacrifice coverage of the bottom end of the broadcast band. The long shafts of these capacitors also make them easier to use with vernier dial drives.

Some constructors may wish to build their set now without waiting for the next hamfest. The first version of the Moorabbin used a 60/160pF plastic tuning capacitor (same as the regeneration control) instead of the 10-415 pF unit substituted later. Receiver performance with the plastic capacitor was good. The main difficulty encountered was coupling it to the vernier dial. This was overcome by extending the shaft with a 2.5 mm diameter screw and a spacer. To compensate for the lower maximum capacitance, more turns need to be wound on to the ferrite rod to cover the whole broadcast band. Details on this are given later.

Vernier dial

It is possible to get by without a vernier dial, but using the set will not nearly be as enjoyable, especially if you want to hear more than just the local stations. Though expensive, it is worth the cost for the benefits you get. You can sometimes find them at hamfests or online. Alternatively you could rig up a 'fine tuning' control with a smaller value variable capacitor or varactor diode-type circuit (which can be done with a regular diode).

Ferrite rod

Ferrite rods in various lengths are available. If your ferrite rod is too long, saw a notch around it with a hacksaw. The rod is then quite brittle and can be snapped cleanly in one's hands.

Transistors

Obtaining these should pose no difficulty. A 2N3819 will work equally well as the MPF102 in the detector and a 2N3904 or 2N2222 can be substituted for the BC548 in the audio amplifier. Note that the lead connections of substitute transistors may vary from those shown in Figure One.

Audio transformer

1k to 8 ohm audio transformers are less common than they were. One thing you could do if you can't find one is to replace it with a resistor in the BC548's collector circuit (try 1k to 10k approx) and wire a high impedance crystal earpiece across it. Or add a coupling capacitor from the junction of the collector and the 1k-10k resistor (approx 1 to 10 uF) and take the audio off there. It won't be enough to drive a speaker but you could use an LM386 or similar stage to amplify it.

Enclosure

Enclosures suitable for this receiver are commercially available or can be made at home. Use a wood or plastic box so that the ferrite rod is not shielded and local stations can be received without an external antenna.

The following may assist you in gathering the parts:

Construction

Preparation

Gather all parts and plan how everything will fit together. Will the tuning capacitor fit inside the case? Does the ferrite rod need to be shortened? Is the front panel large enough to accommodate the vernier drive? How will the printed circuit board be mounted? Will internal leads be short and direct?

Mounting the larger parts

Begin by mounting the larger parts to the case. Install the vernier drive, both variable capacitors, the switch and sockets. Figure One shows the front panel layout in the prototype.

Winding the ferrite rod

The windings on the ferrite rod determine the receiver's frequency coverage, the ability to obtain feedback so important to the set's performance and the amount of coupling

between the regenerative detector and any external antenna.

0.4 mm diameter enamelled copper wire was used for all windings. This diameter is not particularly critical, but 0.4 mm is easy to work with but still results in fairly compact coils.

Wind all coils the same way around the ferrite rod. Use pieces of insulating tape to anchor the ends of each coil. Leave about 2 centimetres distance between each coil. The number of turns for each coil is shown below. Note that if you're using a plastic variable capacitor for the main tuning capacitor you will need more turns on the main coil to cover the lower part of the band. 75 - 80 turns proved adequate in the prototype.

The ferrite rod should be mounted reasonably close to both tuning capacitors and the circuit board. Try to keep leads to the coil 10cm long or less. Find or make some sort of bracket to mount the rod horizontally in the case. This bracket could use rubber grommets and plastic or be salvaged from an old transistor radio. If this is difficult to arrange, don't overlook the possibility of using a ferrite rod longer than the width of the case and drilling holes in both sides to take the rod.

Etching the circuit board

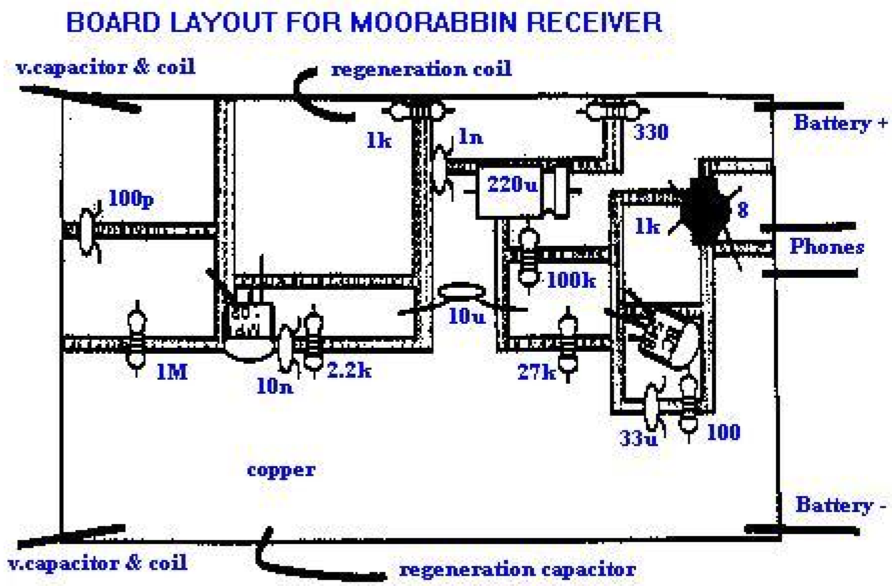
The next part of building the Moorabbin is obtaining the printed circuit board. Where does this come from? You etch it yourself! Don't worry - it's very simple and requires no special tools.

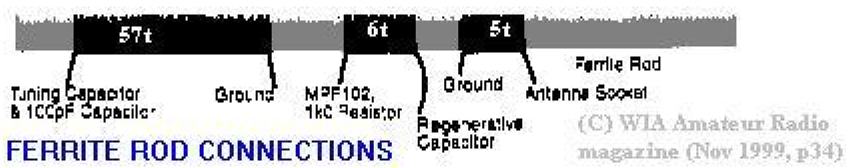
Like with the latest electronic equipment, components are mounted directly on the copper surface of the board. Surface mounting makes construction easier and quicker as it obviates the need to drill holes through the board for each component. It also assists troubleshooting and modification should this be required later.

Cut the circuit board to size with a hacksaw. Then clean the circuit board to ensure a quick etch. Sand the copper surface and finish off with an abrasive powder cleanser (such as Ajax powder) and scrubbing brush. Rinse and dry with a cloth.

Using Figure Two as a guide, stick pieces of insulating tape on the areas of copper that will be used to mount components (light parts get tape).

Figure Two: Circuit board etching pattern and component placement





Place the board copper side down into a bath of etching solution of ferric chloride or ammonium persulphate. Use a non-metallic etching bath and agitate gently to ensure a quick etch.

Mounting the components

Mount the components as per Figure Two. Check that all polarities and component placements are correct. A good way to do this is to trace the connections of parts so that they accord with the circuit and the board layout shown.

Final wiring

Use double-sided tape or stand-offs to attach the circuit board to the case. Then make all the connections between the board and off-board parts, such as the ferrite rod, variable capacitors, sockets, battery snap and power switch. Also check that other off-board connections are in place, such as between the regeneration coil and the regeneration capacitor, antenna coil to the antenna socket and the battery snap to the power switch. Do not overlook the negative (earth) connections joining both variable capacitors, all sockets, the circuit board and the negative power lead.

At this point the receiver is complete. Now time to turn it on!

Switching on

Initial test

Plug in the headphones, connect a wire antenna (any length) and apply power. Turn the regeneration control fully clockwise (ie minimum feedback). Unless you are very close to a broadcast station, you will hear nothing.

Slowly turn the regeneration control anticlockwise. When you pass a certain point, you should hear a faint hiss in the headphones. Adjust the main tuning control until you hear an audio tone (or hetrodyne) which decreases in pitch as you tune towards it. You've just tuned into your first station! Then carefully back off the regeneration control (turn it clockwise) until the hetrodyne stops.

Tuning a regenerative set is a two-handed affair. For peak performance the regeneration control needs to be reset with every station change. Higher frequency stations will need less regeneration than lower frequency stations. As you tune lower slowly turn the regeneration control anti-clockwise to assure best sensitivity and selectivity. Remember clockwise is minimum regeneration and anticlockwise is maximum regeneration.

Calibrating the dial

To know the frequency to which your receiver is tuned, you will need to calibrate the dial. This can be done by seeing where known stations appear on your 0 - 100 dial.

Compare the stations this set receives with those heard on another AM receiver. Exact frequencies of stations can be found on the ACMA website. Make a calibration chart showing the station callsign, frequency and the reading on the vernier dial. Glue this to the top of the receiver. Do all calibrations with the regenerative receiver set to just after the point of oscillation for best accuracy.

Refer to the Troubleshooting section if the receiver misses stations towards either end of the band.

Use without an antenna

The Moorabbin should receive local stations with just the ferrite loopstick antenna. If stations are weak, turn the receiver around for best signal. Stations as far away as Newcastle have been received from Melbourne at night with no external antenna connected. Use headphones for best long-distance reception.

Volume is better on both local and distant stations if an external antenna is connected (longer and higher the better). If overload from local signals is a problem remove turns from the antenna coupling coil or wire a small disc ceramic capacitor (10 to 100 pF) in the antenna line.

Receiving 160 metres

The Moorabbin is capable of receiving amateurs using CW, SSB or AM on the 160 metre band. Amateur signals will usually be weaker than the broadcast stations due to the lower power and compromise antennas most amateurs use.

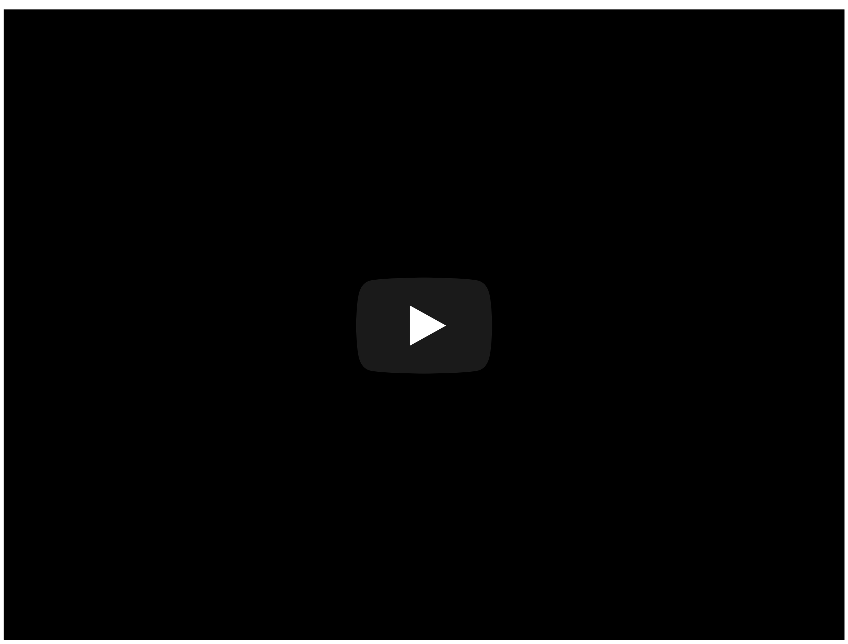
Whether you can hear amateurs on your set depends on several factors. These include the tuning range of your receiver, noise levels and the amount of 160 metre activity in your area. A vernier dial also helps - SSB and CW signals can be tuned in with a regenerative receiver gently oscillating but require greater care in tuning than for AM signals.

Some states transmit WIA broadcasts on 160 metres. SSB stations can sometimes be heard chatting in the evenings. Morse is mainly used by operators seeking international (DX) contacts. As well as random contacts, there is regular scheduled AM activity on 160 metres. Here in Melbourne this includes the 'coffee break' net after 11am Monday to Saturday and the crossband 'missions' from 10:30pm Saturdays to the wee small hours of Sunday.

Other stations

Mainstream AM broadcast stations and radio amateurs are not the only things that can be received on the Moorabbin. There is a growing number of low power special-interest stations operating between the end of the official AM broadcast band and 1.8 megahertz. Reception of these stations is a good test of the Moorabbin's performance. Frequencies such as 1620, 1629 and 1638 kilohertz are particularly popular. Again the ACMA website lists these stations. When AM stations are very weak it sometimes helps to listen with the set gently oscillating, rather than back off the regeneration to just short of oscillation as is often suggested.

Video demonstration of this project



Troubleshooting

If, after applying power, an antenna and headphones, you can't get the receiver to work, check again that all parts have been wired correctly. Use your multimeter to check the set's current consumption. It should be approximately 8mA. Also measure voltages at

various parts of the circuit. If there are significant departures from the values given, there is likely to be a fault.

The following questions and answers should cover most of the problems beginners are likely to encounter with simple regenerative receivers.

Q. What if I hear nothing in the headphones?

Check all wiring. See that both transistors are wired in correctly. Also ensure the transformer is connected the right way - the side with three leads coming out of it is the 1k side which connects between the BC548 collector and the supply rail.

Touching a screwdriver on the base of the BC548 is a way to test the audio stage - if you hear nothing the amplifier is faulty, but if a hum or click is heard the stage is okay.

Q. What if it doesn't oscillate?

Try reversing the connections to the regeneration coil. If this is not successful, add more turns to the coil and try both possible connections of the coil. It should be possible to get the receiver to oscillate with or without an antenna connected.

Q. What if it oscillates over only the high frequency end?

With this fault good reception of stations near the top end of the band is possible, but lower frequency stations are weak and cannot be separated from one another.

Firstly check that your connections to the regeneration capacitor are right. The tag labelled 'G' should be earthed and the 'A' tag should go to the regeneration coil. Do not use the 'O' tag - this is the 60pF section and is too small for our application. If the problem persists, add a few more turns to the regeneration coil.

Q. The set does not appear to cover the entire broadcast band.

If the receiver is not tuning high frequency stations, set any trimmers on the variable capacitor to minimum and try again. If this makes little difference, remove turns from the tuning coil, a few at a time, until these stations can be received. When doing this tune to the bottom end of the band to ensure that lower frequency stations can still be received.

Add turns if you're missing stations near the bottom end of the band. Again ensure that high frequency stations can still be tuned in after any changes made.

If a 60/160pF plastic tuning capacitor is being used for the main tuning control, check that the 'A' tag is being used, not the 'O' tag. If only a small section of the bottom end is missing, try connecting the 'O' terminal to the 'A' terminal to increase the capacitor's maximum capacitance to about 220 pF.

Q. How do I receive 160 metres?

If you're lucky enough to be using a 10-415 pF tuning capacitor, it should be possible to find a number of coil turns that covers the AM broadcast band to the top end of 160 metres in one range. The set pictured covers 530 to 1870 kilohertz, which is ideal. If special care is taken to reduce stray capacitance and inductance, an even wider range is possible. The first version of this set used 'dead-bug' construction instead of the circuit board described here. It tuned 480 to 2000 kilohertz - an unusually wide range for a single variable capacitor and untapped coil.

Those using 60/160 pF plastic variable capacitors may not be able to achieve a tuning range wide enough for both the broadcast band and 160 metres. Either compromise by sacrificing the bottom 50 - 100 kilohertz of the broadcast band for 160 metres or add a switch and coil tap (15 to 20 turns from the end) to provide full coverage over two ranges.

If there is no 160 metre activity while adjustments are being done, there are several ways to establish the frequency to which the receiver is tuned. One is to use a dip oscillator, signal generator or transceiver to produce a local signal on 1.8 megahertz.

Another approach is to use a calibrated SSB communications receiver. Bring a short pickup wire from the receiver antenna socket to near the receiver. Bring the set into oscillation with the regeneration control. It will be possible to find the frequency of the oscillating set by looking for a carrier on the communications receiver. Backing off the regeneration should cause the carrier to vanish. This method is very accurate and is recommended for calibrating the receiver as well as establishing its precise tuning range.

Q. Why won't the receiver work without an external antenna?

A. There are two possibilities. Either you live in a weak signal area, where there are no strong local stations on the AM band, or you built the set in a metal box. If in a weak signal area, try listening at night - in all but the most remote localities stations will be heard with just the ferrite rod.

If you built the receiver in a metal box, pull the whole thing apart and use a plastic or wooden case instead. Because plastic or wood allows signals to reach the ferrite rod, you will be able to use the set without an external antenna in most places.

Q. Don't regenerative receivers cause interference to other radios?

The early days of radio are full of stories about the interference that oscillating regenerative receivers caused to other receivers.

These risks still exist, but are less significant nowadays. In bygone years people used valve sets with large antennas. Today broadcast stations are more powerful and no one apart from long-distance radio listeners connects outside antennas to their receivers. Also the strength of signals emitted by oscillating transistorised regenerative receivers is much less than the original regenerative sets, which used valves.

As an experiment, the Moorabbin was brought to oscillation in the same room as a 10 year old clock radio. The oscillation was weak in the clock radio at 1 metre distance. At 5

metres it could not be heard at all. It is thus unlikely that this set will cause interference to neighbours even when it is used oscillating.

What to do next

This set can be made to operate on lower frequencies by adding turns to each winding on the ferrite rod and parallelling all gangs of the tuning capacitor used. Gradually add turns until stations in the bottom end of the AM broadcast band (530 - 700 kHz) are at the top end of the receiver's tuning range. The main reason why one would wish to do this is to receive the aircraft beacons in the 200 to 500 kHz band and to experiment with receiving the low frequency tests from Tasmania on 177 kHz.

By removing turns higher frequencies can be covered. This will allow reception of some international shortwave broadcast stations, VNG/WWV and the eighty and forty metre amateur bands. This is fun to try, but don't expect top performance; the Moorabbin's plastic case and ferrite rod are okay on MF but not good for HF.

Good results from regenerative receivers are certainly possible on HF. A set more suited to HF was described in *Amateur Radio* June 1998. This solidly-built receiver uses a metal case, high quality variable capacitors and vernier reduction drives, voltage regulation, adequate bandspread, and isolation of the regenerative detector from the antenna to deliver good performance. Factors such as these make the difference between a mediocre performer and one that compares favourably with more sophisticated equipment.

Appendix One - Component list for Moorabbin Receiver

MPF102 FET
BC548 NPN transistor (can be any NPN small signal type eg 2N3904, 2N2222)

100 ohm 1/4 watt resistor
330 ohm 1/4 watt resistor
1k ohm 1/4 watt resistor
2.2k ohm 1/4 watt resistor
27k ohm 1/4 watt resistor
100k ohm 1/4 watt resistor
1M ohm 1/4 watt resistor

100pF disc ceramic capacitor
1nF disc ceramic capacitor
10nF disc ceramic capacitor
10uF tantalum capacitor
33uF electrolytic capacitor
220uF electrolytic capacitor
60/160pF variable capacitor
10-415pF variable capacitor *(see text)*

180mm ferrite rod (100mm also suitable)
1k - 8 ohm transformer
SPST switch
6:1 vernier reduction drive (optional)
9 volt battery snap
6.35 mm headphone socket
BNC panel mount socket

Sundry items: non-metal case, enamelled copper wire (for ferrite rod), single-sided PC board material, hook-up wire, battery mounting bracket, other hardware as required.

Note: This item is an abridged and slightly updated version of a full-length article that appeared in *Amateur Radio*, November 1999.

Further reading on radio and electronics construction

Disclosure: I receive a small commission from items purchased through links on this site. Items were chosen for likely usefulness and a satisfaction rating of 4/5 or better.

[Return to VK3YE amateur radio projects]

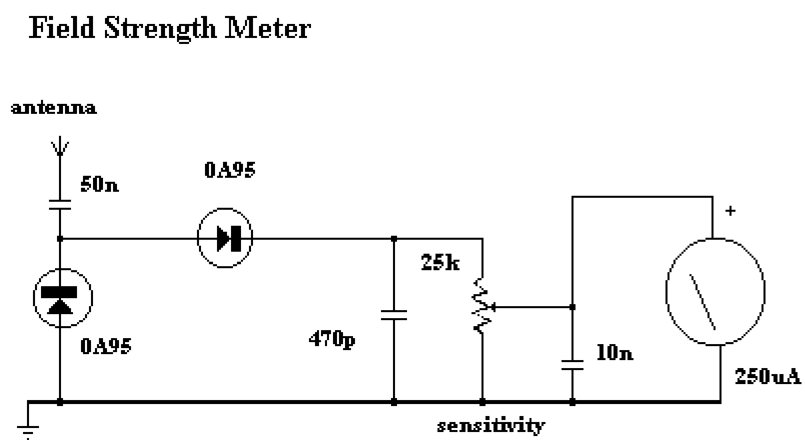
Simple test equipment to build

This time we plug in our soldering irons and put together some pieces of basic test equipment. Though inexpensive, the projects described will prove useful in the radio shack. Any one of them can be assembled in an afternoon. They are described in order of complexity, so that the reader can find a project suitable for their expertise.

Field Strength Meter

A field strength meter is perhaps the simplest piece of RF test equipment that can be built. Used for checking transmitters, antenna experimentation, and testing RF oscillators, field strength meters provide an indication of the presence of RF energy. They are not frequency sensitive and are useful where indication of a change in level is more important than the actual strength of the signal indicated.

Figure One below shows a schematic of an RF field strength meter. Like a crystal set, it requires no power source. However, unlike a crystal set, the meter has no tuned circuit. It responds to signals of any frequency.



The meter works by converting any RF signal present at the antenna to a DC voltage. This voltage drives a meter movement to give an indication of relative RF. The meter includes a control to reduce its sensitivity where required.

Because it uses few parts, a printed circuit board is not necessary; components can simply be soldered to one another. However, a box is desirable for operating convenience. The case and aerial from a discarded toy walkie-talkie was used in the prototype (see photograph), though any small plastic case will suffice. The meter movement need not be large; we are only detecting the presence of RF, and not making precise measurements.

A meter from an old radio or tape recorder should work fine. The diodes can be any germanium type; the actual part number is not important. Germanium diodes can be recognised by their 6mm-long clear glass case with two coloured bands towards the cathode end. None of the component values shown are critical; a 50 percent variation would have little effect on circuit operation.

To test the operation of the meter, a transmitter is required to provide a source of RF. Placing the field strength meter's extended antenna near a handheld VHF rig should produce an indication on the meter, assuming that the sensitivity control has been set to maximum. No indication means that the meter is not working. Common construction errors include connecting the diodes or the meter wrongly and using silicon diodes in place of the germanium diodes specified. In this case, the meter will still work, but with reduced sensitivity. The earth wire is optional; when working with low-powered oscillators, it is useful to clip it to ground (of the circuit under test) to ensure a better indication on the meter.

Those without a transmitter can use an RF signal generator or crystal oscillator (such as that described later) for testing purposes. In this case, place the meter's antenna directly on the output terminal to verify operation. However, only attempt this with transistorised circuitry; component ratings and safety considerations make the meter described here unsuitable for poking around valve equipment.

The field strength meter is a useful instrument in its own right, but it can be made more versatile. Modifications include adding an amplifier (for greater sensitivity), including a tuned circuit (so it only detects signals in a particular band), or converting it into an RF wattmeter and dummy load. Circuits for such instruments are found in the standard handbooks.

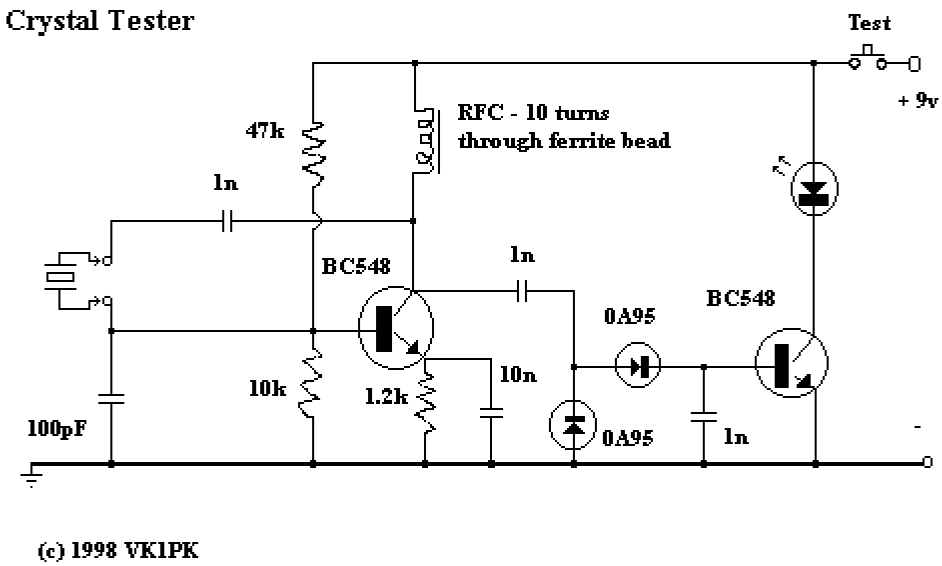
Crystal tester

Below is the circuit of a simple crystal tester. It switches on a light emitting diode (LED) if the crystal is working.

The crystal under test is placed in an oscillator circuit. If it is working, an RF voltage will be present at the collector. This is rectified (converted to DC) and made to drive a transistor switch. Applying current to the base causes current to be drawn through the collector, thus lighting the LED.

If an indication of frequency is required, simply use a general coverage receiver to locate the crystal oscillator's output. Note however that when testing overtone crystals (mostly those above 20 MHz) the output will be on the crystal's fundamental frequency, and not the frequency marked on the crystal's case. Fundamental frequencies are approximately one-third, one-

fifth or one-seventh the overtone frequency, depending on the cut of the crystal.



The circuit may be built on a small piece of matrix board and housed in a plastic box. Alternatively, a case made from scrap printed circuit board material may be used. Either a selection of crystal sockets or two leads with crocodile clips will make it easier to test many crystals quickly. The RF choke is ten turns of very thin insulated wire (such as from receiver IF transformers) passed through a cylindrical ferrite bead. Its value does not seem to be particularly critical, and a commercially-available choke could probably be substituted.

The circuit can be tested by connecting a crystal known to work, and checking for any indcation on the LED. A shortwave transistor radio tuned near the crystal's fundamental frequency can be used to verify the oscillator stage's operation. Note however that this circuit may be unreliable for crystals under 3 MHz, and some experimentation with oscillator component values may be required.

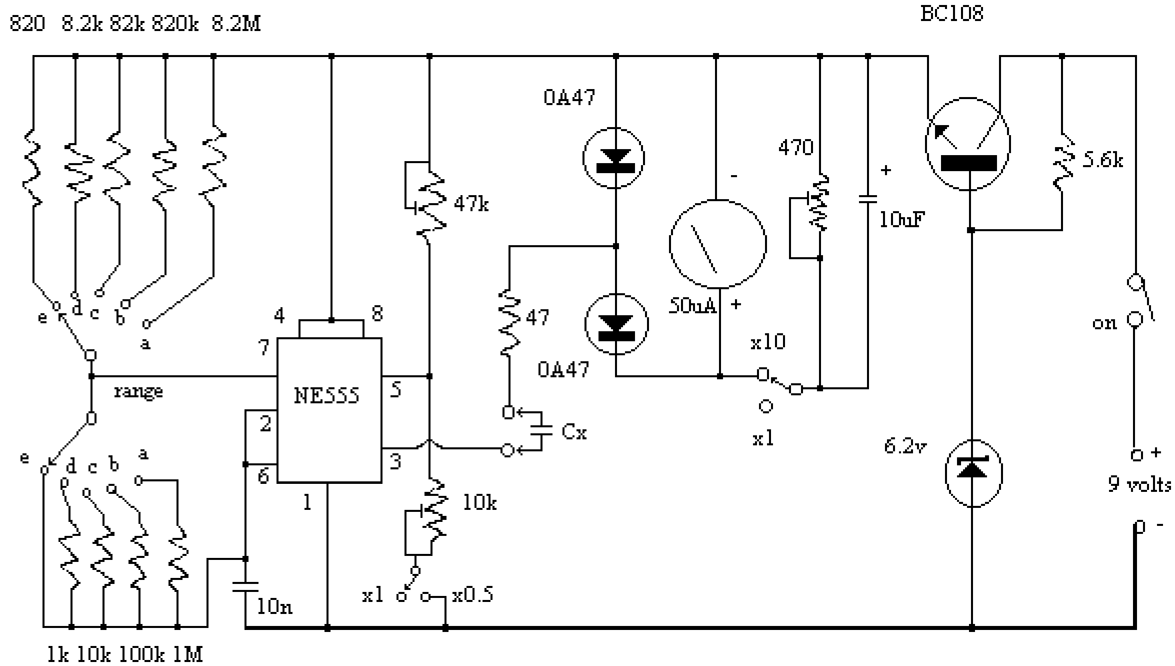
The crystal checker also tests ceramic resonators. Other applications include use as a marker generator for homebrew HF receivers (use a 3.58 MHz crystal) and as a test oscillator for aligning equipment.

Capacitance meter

This project is more complex than the others described earlier. However, when finished, you will have an instrument capable of measuring all but the largest capacitors used in radio circuits. Unlike variable resistors, most variable capacitors are not marked with their values. As well, the markings of capacitors from salvaged equipment often rub off. By being able to

measure these unmarked components, this project will prove useful to the constructor, vintage radio enthusiast or antenna experimenter.

Capacitance Meter



Position	Range
a	1uF
b	100nF
c	10nF
d	1nF
e	100pF

Use x10 switch to measure up to 10uF
Use x0.5 switch for better readings on low values

See text for alignment details

The common 555 timer IC forms the heart of the circuit (Figure Three). Its function is to charge the unknown capacitor (Cx) to a fixed voltage. The capacitor is then discharged into the meter circuit. The meter measures the current being drawn through the 47 ohm resistor. The 555 repeats the process several times a second, so that the meter needle remains steady.

The deflection on the meter is directly proportional to the value of the unknown capacitor. This means that the scale is linear, like the voltage and current ranges on an analogue multimeter.

The meter has five ranges, from 100pF to 1uF, selected by a five position two pole switch. In addition, there is a x10 switch for measuring higher values and a divide-by-two facility to allow a better indication on the meter where the capacitor being measured is just above 100, 1000pF, 0.01, 0.1 or 1 uF.

Component values are critical. For best accuracy, it is desirable that the nine resistors wired to the Range switch have a 2% tolerance. If 0A47

diodes are not available, try OA91 or OA95 germanium diodes instead. Construct the meter in a plastic box; one that is about the size of your multimeter but deeper is ideal. The meter movement should as large as your budget allows; you will be using it to indicate exact values. A round 70mm-diameter movement salvaged from a piece of electronic equipment was used in the prototype. The meter you buy will have a scale of 0 to 50 microamps. This scale needs to be converted to read 0 to 100 (ie 20, 40, 60, 80, 100 instead of 10, 20, 30, 40, 50). Use of white correction fluid or small pieces of paper will help here.

The components can be mounted on a piece of matrix board or printed circuit board. Use a socket for the IC should replacement ever be needed. Keep wires short to minimise stray capacitance; stray capacitance reduces accuracy.

Calibrating the completed meter can be done in conjunction with a ready-built capacitance meter. Failing this, a selection of capacitors of known value, as measured on a laboratory meter, could be used. If neither of these options are available, simply buy several capacitors of the same value and use the one which is nearest the average as your standard reference. Use several standards to verify accuracy on all ranges.

To calibrate, disable both the x10 and divide-by-two functions (ie both switches open). Then connect one of your reference capacitors and switch to an appropriate range. Vary the setting of the 47k trimpot until the meter is reading the exact value of the capacitor. Then switch in the divide-by-two function. This should change the reading on the meter. Adjust the 10k trimpot so that the needle shows exactly twice the original reading. For example, if you used a 0.01 uF reference, and the meter read 10 on the 0.1 uF range, it should now read 20. Now switch out the divide-by-two function.

If you are not doing so already, change to a reference with a value equal to one of the ranges (eg 1000pF, 0.01uF, 0.1uF etc). Switch to the range equal to that value (ie the meter reads full-scale (100) when that capacitor is being measured. Switching in the x10 function should cause the meter indication to drop significantly. Adjust the 470 ohm trimpot so that the meter reads 10. Move down one range (eg from 0.01uF to 1000pF). The meter should read 100 again. If it does not, vary the 470 ohm trimpot until it does. That completes the calibration of the capacitance meter. Now try measuring other components to confirm that the measurements are reasonable.

With care, an accuracy of five percent or better should be possible on most ranges.

Parts availability

Most parts for all three projects should be obtainable. Instances where you might have some difficulty include: (a) Meter movement. These are becoming rarer and dearer. Hamfests and junk equipment sale are one source. If this fails you could use a digital meter in place of the analogue meter. Or use your multimeter on a low current setting instead. (b) OA47 diodes. Although not exactly the same germanium diodes as used in crystal sets may be suitable. (c) BC108 transistor. Can be any small signal transistor eg 2N3904 or 2N2222.

Reference

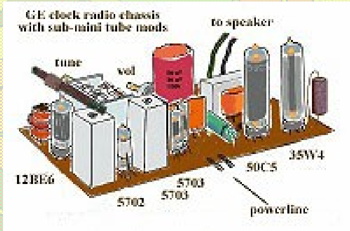
Hawker, P Amateur Radio Techniques, Seventh Edition, RSGB, 1980

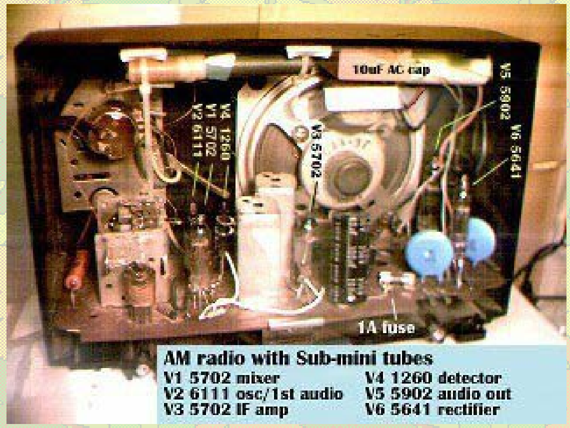
Further reading

[A Guide to Test Equipment]

This article appeared in *Amateur Radio* April 1997 with minor updates since.

[Books by VK3YE]





All American 5 sub-mini tube AM radio, what if?

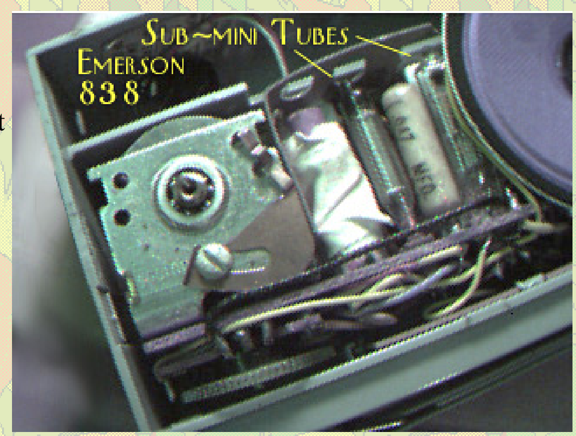
>| : : : |-

to >| : : : |-

Infinite impedance detector for higher AM reception fidelity

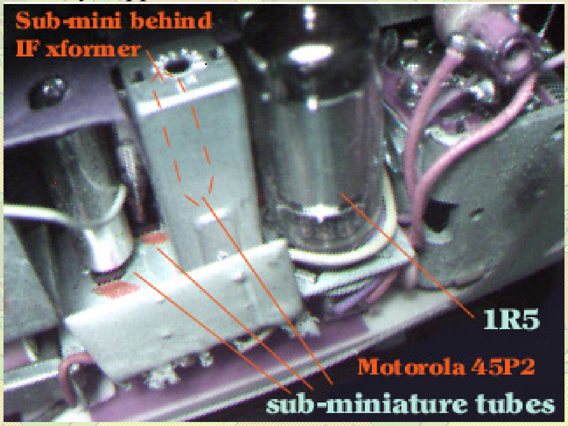
An AA4 modified with a radio IC for better reception

> What if a subminiature version of the "All American 5" tube AM radio had been developed and produced? I modified a few common circuit board based AA5's replacing the regular tubes with sub-mini's.



Production AM portable radios using sub-miniature tubes were made by Emerson and Motorola. AFAIK, no production AM table radios were made using sub-mini's. The image above right, from a Motorola 1955 brochure, implies that submini tubes were used in their clock radios, but I don't think that

actually happened.



First an easy substitution: A JRP-5678 filament tube in place of a 1U4 filament tube in a portable radio. Note that a 47K resistor needs to be inserted between the 1U4 pin 3 and the 5678 pin 2, also a 0.01uF cap needs to be connected between the 5678's pins 2 and 3. This is to reduce the screen voltage from 90V to 67V, and to bypass the screen to the filament for an RF ground.


```
1U4 pin 5678 pin

1       3---\
2       1  0.01uF
3--47k--2---/
4       nc
5       3
6       4
7       5
```

That's right, the 5678 pin 3 connects to both the 1U4's pin 1 and 5. Also note that the filament DC supply should have pin 3 of the 5678 more negative than its pin 5. The control grid is built expecting this. Same is true of the 1U4, its pin 7 should be the more positive filament pin. An alternative method of bypassing the screen grid is to connect a 0.1uF low voltage cap in parallel with the 47K resistor instead of the 0.01uF cap to pin 3 of the 5678. This alternative bypasses the screen grid to B+, which should be a good RF "ground". You shouldn't need to touch the alignment of the IF strip. Data on the 5678.

The following description explains how I substituted sub-miniature tubes for the regular 7 pin tubes found in AM radios. You should have a good amount of experience working with tube based analog RF electronics if you want to actually do this. That also means you know about the shock hazards and such safety issues. Another radio built using compactron tubes is very similar to the below description. Only real difference is the "packaging" of the active elements of the vacuum tubes.

I modified 3 "AA5" AM tube radios that were built using circuit boards. *Before doing anything else, verify that the radio is fully functional, decent reception, low/no hum or distortion. Fix any problems before attempting these mods!* The first one, a GE clock radio from the early 60's, I removed the 12BA6 remote cutoff pentode IF amp tube and the socket (use solder wick, these circuit boards can't take much abuse) and installed a 5702 sub-mini remote cutoff pentode tube. The sub-mini usually comes with wire leads about 2 inches (5 cm) long, and you can bend somewhat the leads to form a pattern such that it duplicates the same functional pinout as the 12BA6 (cathode=cathode, g1=g1, etc). If there is no cathode resistor, add a 180 ohm resistor, otherwise replace the existing one with a 180 ohm resistor. Tube will probably oscillate some with values lower. Also, *IMPORTANT* This tube needs an external grounded shield. Otherwise, it will oscillate on you. The 12BA6 has one built in, but the sub-mini's don't. Any convenient solderable metal formed into a round shield will do, you only need cover the portion of the tube where the plate lives. That way, you can still see the top of the tube's glass bulb, and also more importantly, avoid shorting to the wire leads. Solder a wire to the shield, and connect it to RF ground in the local area. I used a piece of wire stiff enough to hold the shield mechanically in position. Now, it's time to test it. Yes, I realize that the heater current of the 5702 is 200ma, and the rest of the radio is 150ma, but it will work well enough to verify things at this time. You may want to use a variac and bring the line voltage up slowly with the radio on. Check to see all the tubes are glowing at reasonable levels, note that the sub-mini will be a bit brighter at first. but should settle down in a few seconds. Radio should start playing, tune around the dial. If not, check the wiring you did.

Assuming success so far, we now turn our attention to the 12AV6 detector/avc/first audio tube. We will use two 5703 triode tubes here, one will be the detector and AVC tube, the other will be the first audio amp triode. A triode for a diode function? Yes, the cathode will be tied to ground, and the grid tied to the IF transformer output. And the plate will be used as an internal shield, tie it

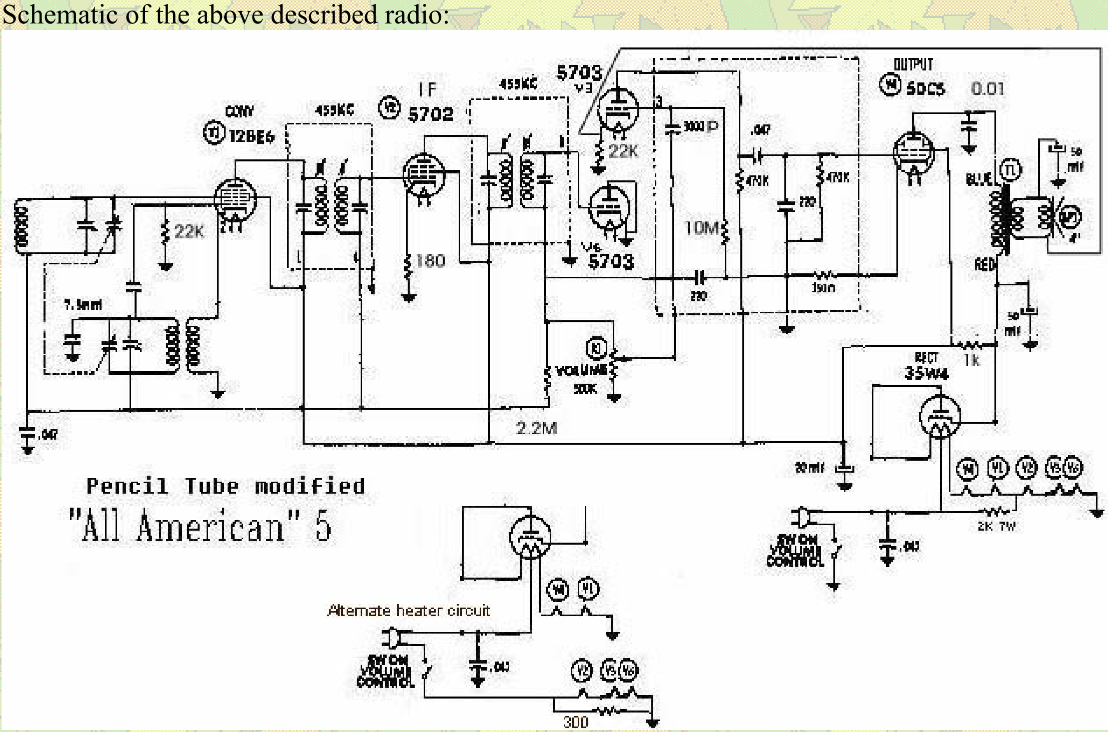
to ground. And the first audio amp triode's cathode goes to ground, like the 12AV6's did, and grid to grid, plate to plate. If the fidelity of the audio amp triode is too distorted, inserting a 22K ohm resistor (value not critical) between the cathode and ground may help. Better fidelity can be had if some negative feedback from the speaker winding of the output transformer is applied to this cathode resistor. This is now possible now that the diode detector cathode and the first audio amp cathode are separate. Be sure to pay attention to the routing of the heater currents (the 12AV6 usually is at the signal and power ground of the series string heater circuit, and one of its heater pins is grounded. To avoid introducing hum into the audio, use the same physical location to ground the detector/AVC 5703 tube heater as used by the 12AV6 heater. Or else you may get ground loop problems. The circuit board designer back when went to some effort to avoid ground loop problems. Connect the other end of this tube's heater to one of the other 5703 triode heaters, and the other heater of that tube goes to the other heater connection the 12AV6 used. According to the RCA Tube Manual, the preferred order of the series string heater order is to have the detector tube at ground, than the first audio triode, then the IF, etc. Test the radio bringing up the variac with the radio on. Should work, if not, check the wiring.

Assuming again success, we now address the heater current difference. In my radio, the detector/AVC tube, then the first audio tube, then the IF tube were wired in series. Then came the 12BE6, the 50C5 and then 35W4. To provide the new tubes an extra 50ma of heater current (to bring it up from 150ma to 200ma) add at the IF tube - 12BE6 heater node a 2K 10W resistor and the other end of the resistor to the top of the heater string, at the power input node. (The other side of the power line, the one not connected to the radio's system ground (probably thru the power switch)). If the radio had the 12BE6 heater between the IF tube and the first audio and detector tube(s), you'll need to wire in parallel a 250 ohm 1W resistor across the 12BE6 heater, and attach the above 2K resistor to the new IF tube - 50C5 node. Test it again, carefully measure the AC volts on the heaters of the new tubes to see that they are at reasonable values (±10% is fine). And the radio should still work!

Another way to power the 200ma heaters would be to insert them between the radio's ground and the incoming powerline (usually thru the power switch). Thus the heater string pulls its current thru the submini tubes with the 200ma current rating. When the rectifier tube and other tubes are warm enough to conduct current thru their cathodes, this current will add with the heater string current to pass thru the submini tube heaters. At this point this current is not a constant DC, but it consists of filter capacitor charge pulses. But the heaters are essentially pure resistances once up to temperature and it doesn't matter. But you'd need a true RMS meter to measure it correctly. You may need a resistor of around 100 ohms across each submini tube as the added current will be a little too much. With a suitable resistor in parallel, this technique can heat any tube where the heater current is between 150ma to 260ma. Keep in mind that this will reduce the radio's B+ supply voltage.

One could use a capacitor instead of the resistor to provide the extra current thru the heaters of the new tubes. Realize that the current thru the cap will be "imaginary" (I hated this term in math class, to me, "imaginary" meant "fake"). The 150ma of current thru the other AA5 tubes would be "real". We need to do vectors here, to get a final result of 200ma thru the new tubes. Doing the trig yields about 130ma of imaginary current, and approx size 3.3uF 250VAC cap will provide this. One could do "S" parameters to solve this problem as well, just like back in ECE232 class at Syracuse University in 1976.

Schematic of the above described radio:



I had thought that this infinite impedance detector would offer better fidelity on weak signals, but I've since found that the usual diode detector works better, if you remove the AVC circuit from its output. To furnish AVC, use the other diode in the 12AV6 or

12SQ7. Connect a 100pF cap from the plate of the IF tube to the new diode, and a 470K to 1 meg resistor from the diode to ground. the 2.2 or 3.3 meg AVC resistor that was attached to the detected audio now goes to the new diode. This removes the back biasing of the detector diode caused by the stored charge on the AVC filter cap. Which causes clipping on modulation valleys. But if you want to play with the infinite impedance detector anyway, read on.

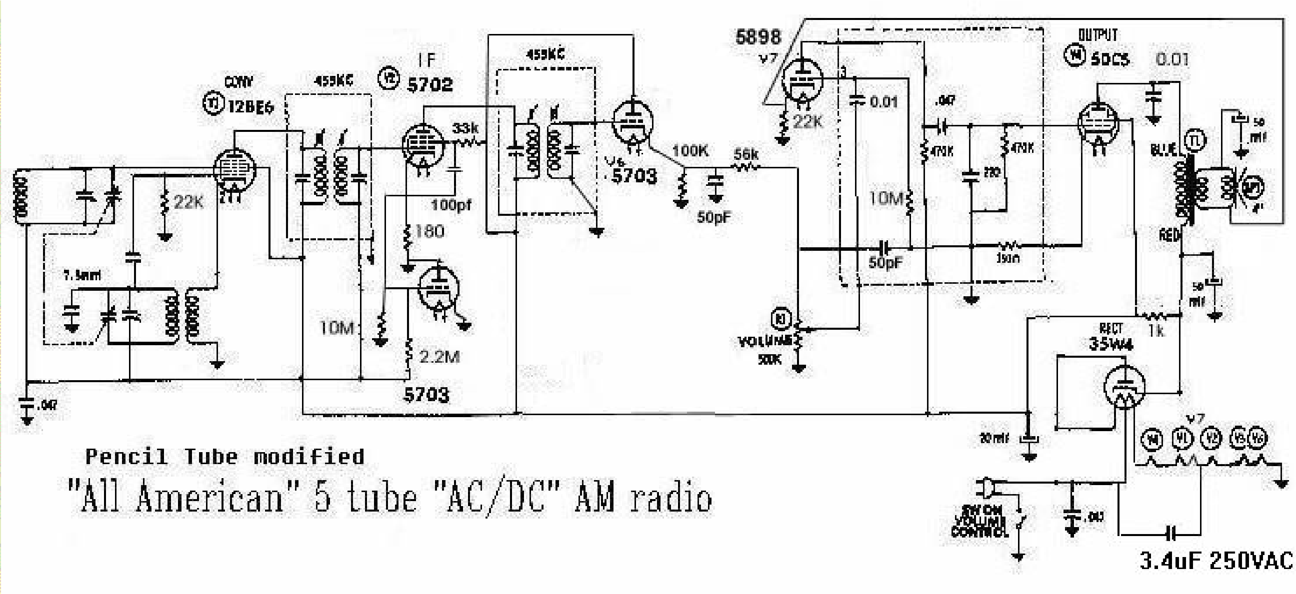
For better fidelity on weak stations, one could change the AM detector circuit to a high impedance type. A triode connected as a cathode follower will provide this. Known as the "infinite impedance detector", the "reflex detector", the "negative feedback detector", or the just plain "feedback detector". The diode detector was scrapped in favor of the infinite-impedance detector which is just as capable of handling large signals as the diode and which handles small signals with less distortion. The infinite-impedance detector is nothing but a cathode follower with a large cathode resistance to bias the tube almost to cutoff. This detector presents a very high impedance across the secondary of the last i.f. transformer so that there is no loss in Q as with a diode detector which has a relatively low impedance. The cathode resistor is 100K. It also has a filter cap (50pF) that charges up and holds between cycles of the 455KHz modulated sine wave the peak of that cycle. The RC time constant is chosen to discharge fast enough to follow the audio waveform, but not fast enough to allow 455KHz thru to the audio amp. The tube does the work of charging this filter cap, thus off loading the IF transformer. The cathode follower has a low impedance during the peak of the cycle as it charges the cap. Other times it does not conduct as the grid is taken negative by the IF signal and the cathode cannot follow because of the charge on the cap.

We still need a way to get AVC. A separate detector diode coupled via a 100pF cap to the IF amp tube plate will provide this. But that brings us back to the loading problem the original detector diode had. We could just forget about AVC and just use a manual RF/IF gain control. To do this, ground the old AVC line, and break the ground line that feeds the front end and IF tubes. In that break insert a 5K pot with one end to ground, and the wiper going to the tubes' "ground" supply. Bypass the pot wiper with a 0.1uf cap to ground. This will work if you usually listen to only one station. But if you tune around a lot, you'll want real AVC. Ideally, if we had a pentode with two separate plates, one feeding the IF transformer and the other feeding the AVC diode, this would avoid this loading problem. Another way is to use the screen grid as a kind of plate. Have the screen grid feed thru a resistor to B+. And connect via the cap the AVC diode to that. Only thing is that the IF pentode starts looking like a triode. The capacitance of the control grid G1 on the IF transformer feeding it will increase due to the Miller effect. Being the IF stage helps in that the frequency doesn't change like it would if we were working in a TRF set. This extra capacitance can be tuned out by adjusting the IF transformer. Oh, the Miller effect will vary slightly depending on the bias of the tube due to the AVC, but that is not a real problem. Using the screen grid instead of a separate tube means that the IF tube control grid (which has a remote cutoff curve) is included in the AVC feedback loop. A separate tube may have a differing remote cutoff curve thus giving poor AVC action.

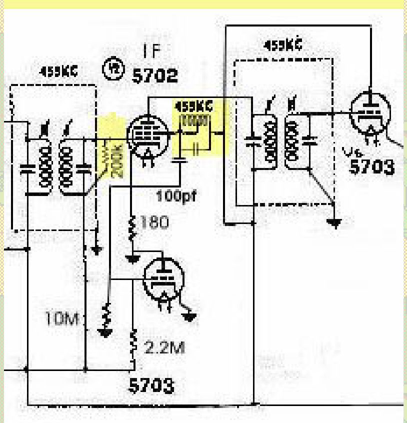
An additional improvement can be had by replacing the screen resistor of 33K with an IF transformer from a transistor radio. This allows the screen voltage to be more stable and increases the amplitude of the IF signal as seen by the AVC circuit. The tap of the transistor radio IF transformer is usually not in the center of the coil electrically speaking, but off to one side. The screen goes to the tap, B+ to the end of the coil that measures less resistance on an ohmmeter, and the AVC cap to the other end. I wouldn't use the secondary as the insulation on the magnet wire used inside the transformer probably won't stand the B+ voltage between windings. You may get birdies though. I damped these out by installing in parallel a 200K resistor across the secondary of the first IF transformer. Miller effect will increase some, so that will need to be tweaked out.

For more fun, let's try neutralization like that found in early transistor radio IF strips. There they take some out-of-phase output and feed it back to the transistor base thru a very small cap of about 1.5pF. The transistor radio transformer we used above still has a secondary that we can put to good use for this. The trick is to connect the secondary so we do in fact get an out-of-phase signal. My particular transformer was wound so that connecting the B+ from the pin that currently has it to the pin diagonally opposite did it. Be prepared to change it if necessary. A 1.5pF or so cap connects to the other pin of the secondary to the G1 of the IF tube. I removed the 200K resistor I had on G1 before. It will probably oscillate when you first fire the radio up. Careful tweaking of the various IF transformers will be needed. Setting some a little high and some a little low should make it unconditionally stable, or unconditionally unstable. You'll know which mode you're in. This is probably too twitchy for mass production, though. I eventually abandoned this and did the down below with the infinite impedance detector triode plate.

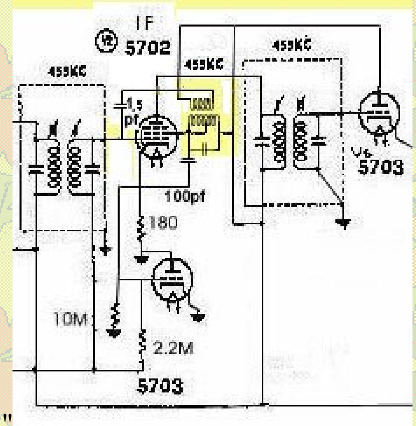
You don't have to use submini tubes for this. A 12AU7 for the infinite impedance detector and audio driver would work. A triode with low mu would be preferred. A 12CR6 pentode/diode should work for the IF amp and AVC diode.



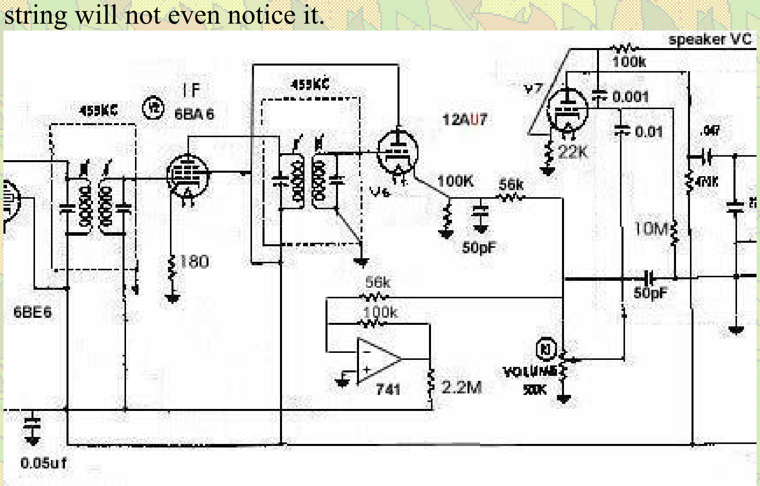
"Additional improvement"



.."Neutralization"

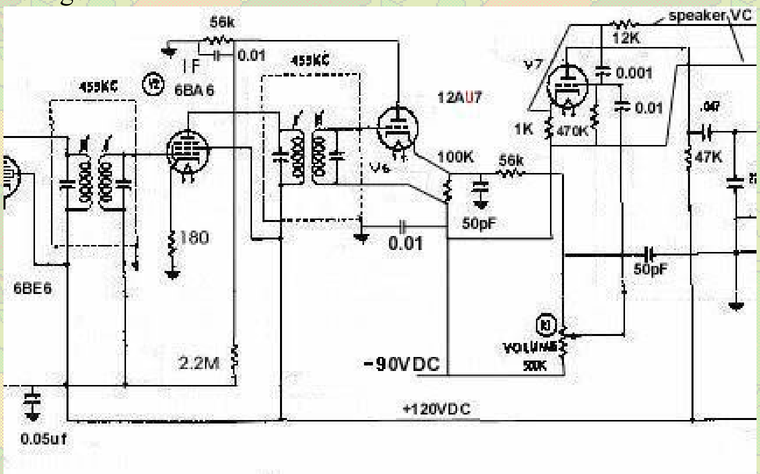


If you are willing to use some sand, another way to develop the AVC voltage is to use an op-amp in inverting mode. You need a source of positive and negative 12 to 15V for the op-amp. The op-amp output feeds into the AVC filter (usually 2 to 3 meg resistor and 0.05uf cap). The input to the op-amp circuit is a 56K resistor connected at the top of the volume control (this is audio (455KHz filtered out) including the DC bias indicating signal strength). The other end of the resistor goes to the "-IN" (inverting input) pin of the op-amp. The audio volume will decrease a little, as the 56K resistor will look like it's going to ground. The "+IN" (non-inverting input) goes to ground. To complete the circuit, a feedback resistor of 100K is connected between the "-IN" pin to the output pin of the op-amp. This creates a gain of negative 2. This is what we need because as signal strength increases, the infinite impedance detector output increases in DC bias in a positive voltage direction. We need the inverse of this, which the op-amp circuit provides. Connect the positive 12 to 15V supply to the positive supply pin of the op-amp, and likewise the negative supply. Leave the rest of the op-amp pins no connection. To make these supplies, one could grab off the heater string 12.6VAC and rectify a positive supply and a negative supply, with filter caps. As the op-amp requires little current, the heater string will not even notice it.



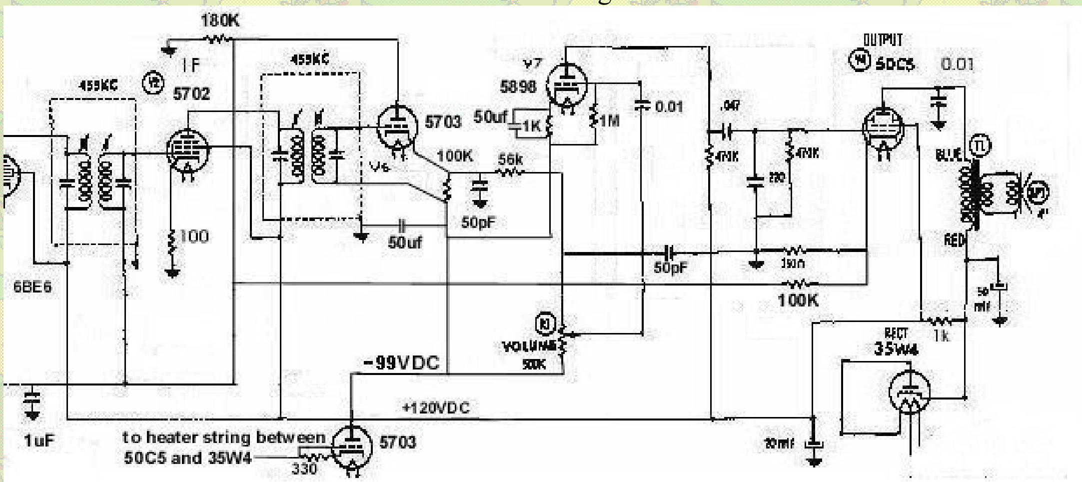
Another solution is to make use of a negative supply of about 90VDC. This can be generated by a diode and 12K resistor in series off the line and filtered by a cap of about 100uF. I had the voltage at -150VDC, but that would exceed the heater-cathode voltage spec. The infinite impedance detector circuit is tied to this negative supply. Also the cathode and grid circuits of the audio driver triode are tied to the negative supply. As well as the volume control. This is to reduce the effect of any hum on the negative supply from getting into the audio signal. Also makes for more effective plate voltage on the audio driver triode.

The whole point of this use of the negative supply is to allow the infinite impedance detector triode to also function as a DC coupled inverter. A plate resistor of 56K going to ground will produce a negative voltage related to the positive voltage of the cathode and related to signal strength of radio stations. You can increase or decrease this resistor to vary the gain of the AVC voltage. Useful to increase if you are getting distortion on strong signals. We can directly use this after filtering as the AVC voltage.

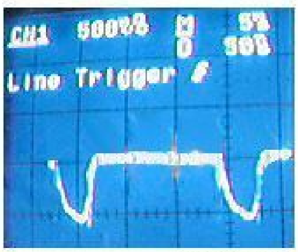


You don't even have to use the old 2.2M resistor and 0.047uF cap. Connect the AVC directly to the plate resistor and bypass it with a 1uF cap. Depending on your selection of IF and detector tubes, the quiescent current thru the detector triode may bias the AVC voltage too much for low signal strengths. A way around this is to bias the ground end of the plate resistor up a few volts to null the quiescent voltage. I effectively did this by using another resistor connected to the AVC line to the 50C5 output tube cathode, which has around 6 to 7 volts of DC (and some audio signal riding on it too, but the above 1uF AVC filter removes any trouble from that). I used the leftover triode as a rectifier. I connected the grid to the cathode with a 330 ohm resistor, so the tube

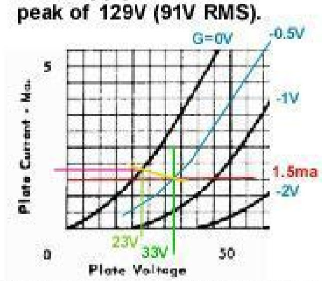
is current limited to that of a triode with -0.5V on its grid.



Voltage waveform across the 330 ohm resistor between the cathode and grid of the 5703 triode being used as rectifier



At the peak of the rectifier conduction, the grid, biased to minus 1/2V, limits current to 1.5ma. That produces a drop of ~33V to produce -99V supply from an AC peak of 129V (91V RMS).



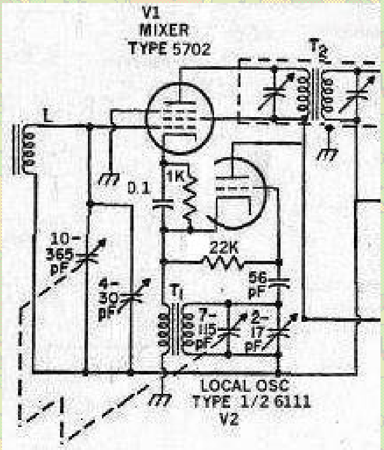
At 0V grid voltage, supply increased 10V, as did current draw a little because the load sank more current.

Be aware that during the night, out-of-town co-channel stations' carriers can interfere with a more local weak station's carrier. This can cause the carrier level to be lowered at times, creating distortion in the detected audio. This doesn't happen to the sidebands, as these are not related local station to the out-of-town stations. Try listening to another weak station, or during the daytime.

2nd radio was essentially a continuation of the above. Except a section of a 6111 twin triode served as the first audio stage (better sound was had with a 22K ohm resistor between cathode and ground), and a 1260 diode was used as the detector. *I did the following to replace the 12BE6. First I did the local oscillator using one of the triode sections of the 6111. Then on to the mixer function. The first method (cathode injection) of doing the mixer performance was about as good as that with the 12BE6. The screen grid injection in general was a little poorer performance. The dual control pentode (5636) used as a mixer method worked well and had less local oscillator pulling*. This would be the preferred circuit, as well as the first mentioned cathode injection of the local oscillator. This can be more difficult than the above IF, 1st audio, and detector mods.

First thing to do is get a second AM radio (any type, need not be a tube radio) and tube in a weak station above 1000KHz. And turn on the radio you're doing the mods to, and after you verify that it receives stations, tune to a spot on the dial 455 KHz lower than the weak station being received on the other radio. With the two radios about 2 feet apart, you should hear a heterodyne whistle "jamming" the weak station on the non-mod radio. You are hearing the mod radio's local oscillator leaking out into the air. Normal. European governments used this trick to hunt for people who didn't pay some sort of "radio tax" or something. Anyway... If possible, leave the socket in place, and attach the tube wiring on the bottom (foil side) of the board, using the tube socket solder nodes as places to solder. If the following is successful, you can rewire things to live on the top side of the board. If it's not satisfactory, remove the attempt and reinstall the 12BE6. On this optimistic note, let's continue: Using a 6111 twin triode, connect the cathode to the cathode pin of the 12BE6 socket, grid to G1 pin, and plate to the g2,g4 pin (which should be the local B+ line). The mu (20) of the 6111 tube is the same as the mu (20) of the oscillator portion of a 12BE6 (cathode, g1 and g2 (which corresponds to the plate of the 6111)). No mods to the oscillator coil or cap are needed. (The other section of the twin triode will be the first audio amp. Better sound was had by using a 2K ohm resistor in the cathode circuit of this audio stage, and paralleling a 56K resistor across the plate resistor of 470K). Connect the heaters to the heater pins. Fire the radio up, and with the other radio tuned to that weak station, tune around the dial on the mod radio, and if the triode tube is working, you should hear the local oscillator. You won't hear any stations on the mod radio now, next thing is to add a mixer tube.

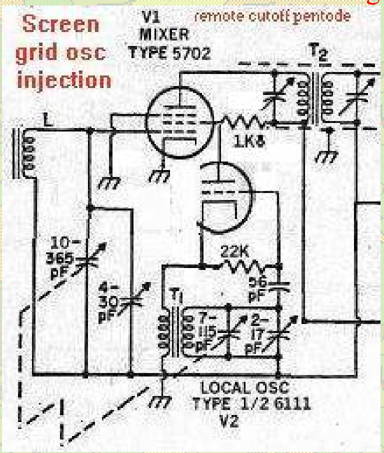
First method:



(On the left is a portion of the below circuit diagram, featuring the cathode osc injection)

Using a 5702 pentode, connect its plate to the 12BE6 plate pin, its grid 1 to pin 7 (g3) of the 12BE6 socket, g2 to B+, and connect g3 and the cathode of the 5702 pentode together, and to a 68 ohm resistor and a 0.1 or so cap. The other ends of these resistor and cap connect to the cathode pin of the 12BE6 socket. And insert in series the heater. Now fire up the radio again, see if you hear any stations (may be weak), and also see if the other radio can still hear the local oscillator. You may need to adjust the value of the 1K ohm resistor above to get better results in signal strength. This is very similar to the mixer in the [radio built using compactron tubes]and should work fine. As mentioned before, you may have more difficulty here than with the previous IF , detector and 1st audio tube mods. You can always go back to using the 12BE6. Don't twiddle with the alignment too much, it would only have impact on the upper end of the band. The lower end of the band doesn't much notice small differences in capacitance, and the above mod would only affect capacitance, and not inductance.

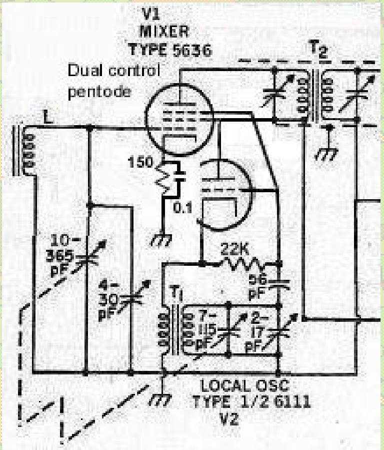
An alternative mixer circuit using screen grid local osc injection:



(On the left is a portion of the below circuit diagram, featuring the screen grid osc injection)

Instead of injecting the local osc into the cathode of the mixer tube, inject it into the screen grid (G2). Insert a 1K8 (1800 ohms, Europeans use the "K" in place of the decimal point "." to improve readability, as the "." is small and can get lost in the dust. 1K8 -> 1.8 * 1000 -> 1800, 1000 for the "K") resistor between G2 and B+, and connect the plate of the local osc triode here. And instead of the mixer cathode resistor described above, connect the cathode to ground. And remove the cap between this cathode and the local oscillator tube cathode! A downside is that a strong station may "pull" the local oscillator. A larger value of this new resistor will make this happen more, make it too small and the conversion gm will drop, making sensitivity go down. As the transconductance of screen grids is pretty low, this method won't have much gain. The mixer tube is acting as a multiplier, make the local oscillator amplitude smaller (smaller value resistor in osc plate circuit) and the signal being the same strength, will yield a lower amplitude product (IF signal at 455KHz). Be aware that a larger amplitude osc signal on the osc tube plate will cause some "Miller effect" (like you get in transistors) and shift the osc frequency a little (this is separate from the above mentioned "pulling"). This is the least satisfactory of these three methods, and is mentioned as an introduction to the next below method, which uses a specially designed G3 instead of G2.

Yet another alternative mixer circuit using a dual control pentode:



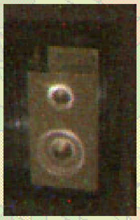
(On the left is a portion of the below circuit diagram, featuring the dual control pentode used as a mixer)

Here a dual control pentode (5636) is used as a mixer. A dual control pentode has two control grids, G1 and G3. What would be the suppresser grid is the second control grid. This grid is connected to the oscillator grid, and thus it "chops" the signal from the antenna (applied to the first control grid). This causes heterodyning mixing action to occur. This circuit has more conversion gain (the 5636 is rated to have a conversion transconductance of 1280 umhos) than the above screen grid injection, and the oscillator has less amount of "pulling" from strong stations. Be sure to add an additional 120 ohm resistor in parallel with the heater, as the 5636 draws 50ma less heater current than the 5702.

I then went on to the 50C5 audio output tube and the 35W4 rectifier tube. I used a 5902 beam power sub-mini for the audio output stage. Its rated load is 3000 ohms for 1 watt, vs. 2500 ohms and 1.9watts for the 50C5. Close enough load specs, the slight difference will mean slightly less output power. At this point, it's a direct pin for pin function substitution *except for the heaters*, and the cathode resistor changes to 270 ohm. And I used a 5641 rectifier to substitute for the 35W4. An 18 ohm resistor in series with the cathode limits the peak capacitor charging currents to below this rectifier's peak current rating of 200ma.

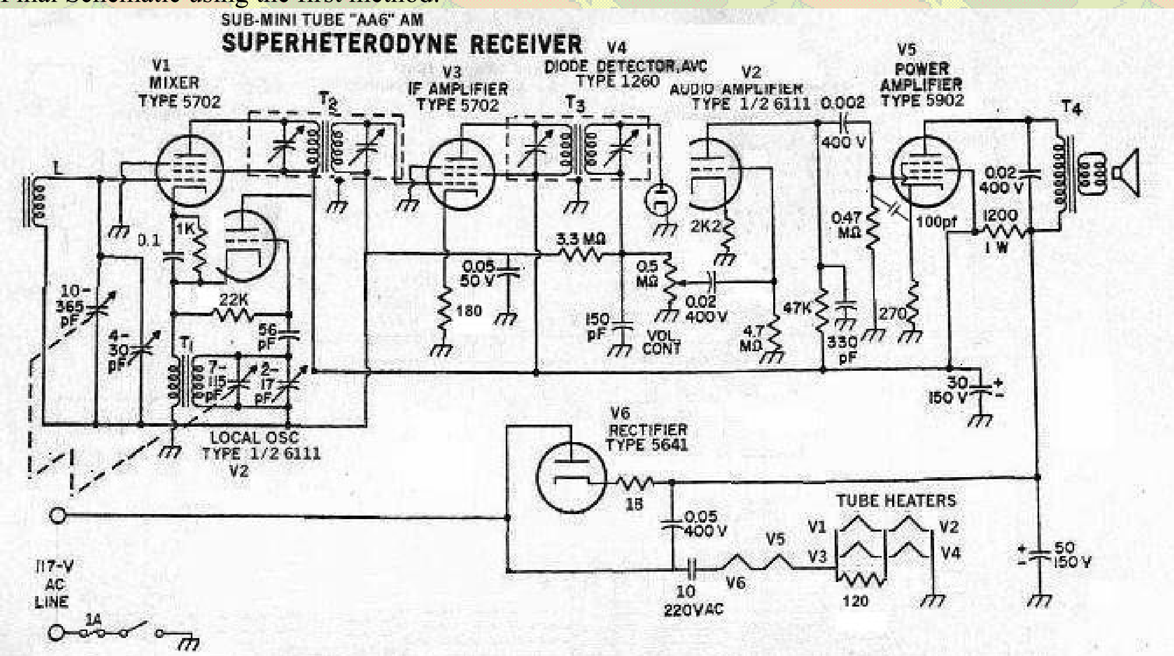
At this point, I rearranged the series string heater arrangement. Using a 10uF AC capacitor, rated for 200V at 60 Hz (1.4KVDC), to drop the power line voltage down to 24V at 450ma AC, provides the heater power. This first feeds into the rectifier tube, which consumes all 450ma, at 6.3V. Then this in turn feeds in series into the audio tube, which also takes all the current at another 6.3V. At this point, the rest of the tubes consume less heater current, so a series/parallel arrangement is used. The pentode tubes (mixer and IF) consume 150ma and 200ma each respectively, or 350ma when wired in parallel. Add a 60 ohm resistor in parallel to make it 450ma. Or use a pair of pilot light bulbs, 6V @ 25 ma each, (Radio Shack has 'em) wired in parallel with the 5636 and 5702 heaters and a 120 ohm resistor. These heaters, along with the capacitor, will limit the current and voltage the

bulbs will see. And this configuration then feeds into the 6111 twin triode (300ma), and in parallel, the diode detector tube (150ma), for a total of 450ma. These two last tubes' heaters then connect to ground. I had first used a transformer to power the heaters, but it was rather big. One could easily imagine a higher heater voltage sub-mini beam power and rectifier tubes, but aside from the 7762 pentode (same as the 5902 except for a 26.5V@110ma heater) none were actually made. I haven't been able to find any 7762s, maybe they were just "vaporware". Data sheets in pdf form: 5636, 5641, 5647 (similar to the 1260), 5702, 5703, 5902, 6111, 6BA6, 6BE6.



Here the above pilot lights are lighting the radio dials in the dark.

Final Schematic using the first method:



When using a separate diode, like an EA76 or 5647, better detector fidelity can be had by reducing its contact potential. You can reduce the contact potential by reducing the heater voltage down from 6.3 to 4 volts. In a series string, that can be done by paralleling a 100 ohm resistor with the heater. In this series/parallel set, an extra 15 ohm resistor is used. This should increase the fidelity of AM detection. The 5896 below is a dual diode version.

In critical detector applications, a reduction in hum output and contact potential voltage may be realized by lowering the operating heater voltage. Such a reduction will, however, result in a plate characteristic curve which departs from that obtained with rated heater voltage, Figure 2. With practical values of reduced heater voltage, hum output may be lowered by as much as 60% and contact potential by 20 to 30%. Operation under these conditions is satisfactory, providing the current requirements are consistent with values normally encountered in low level detection. An alternative method of lowering hum output is to bias the heater with respect to the cathode.

5896 detector diode

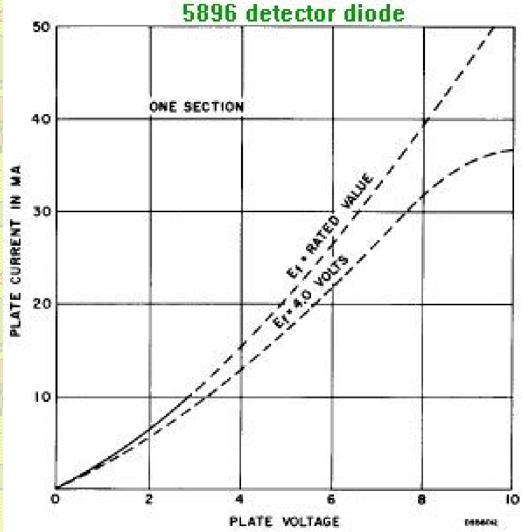
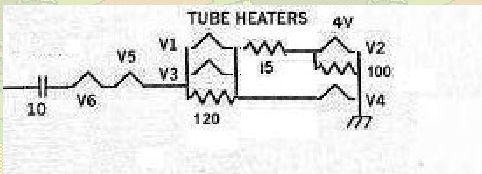
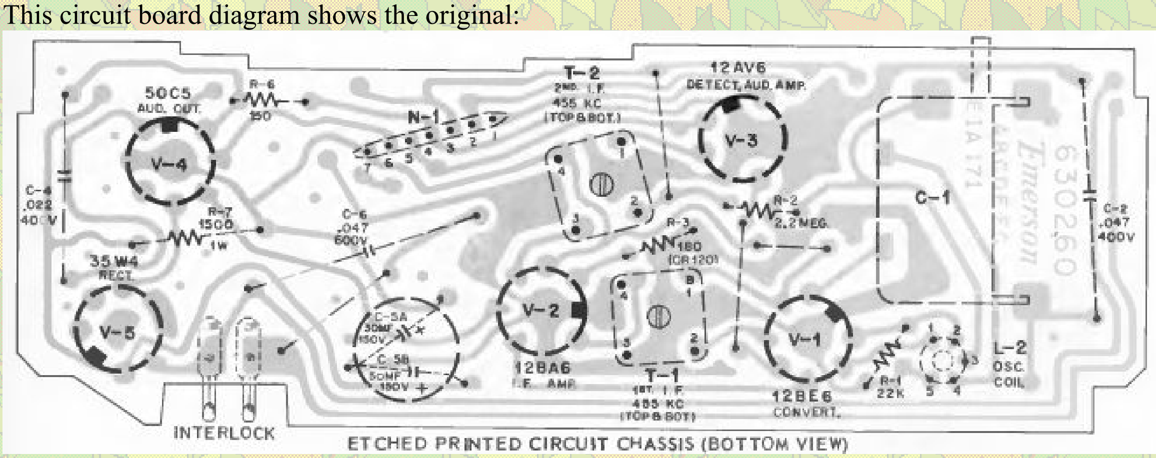


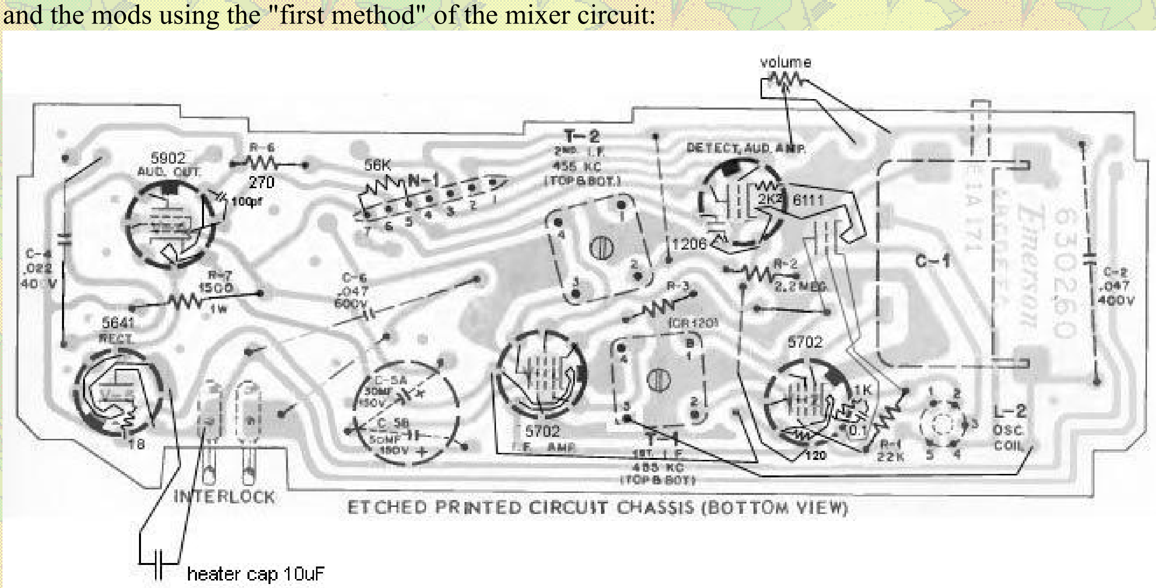
Figure 2 Approximate Plate Characteristics at reduced heater voltage



This circuit board diagram shows the original:



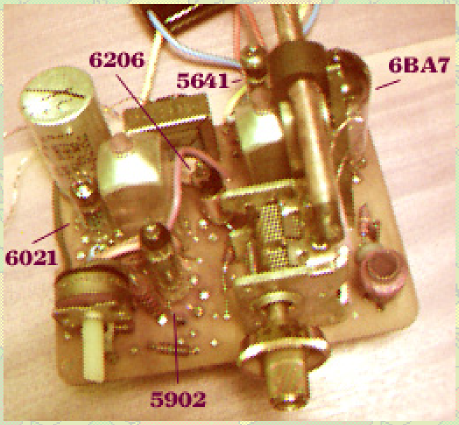
and the mods using the "first method" of the mixer circuit:

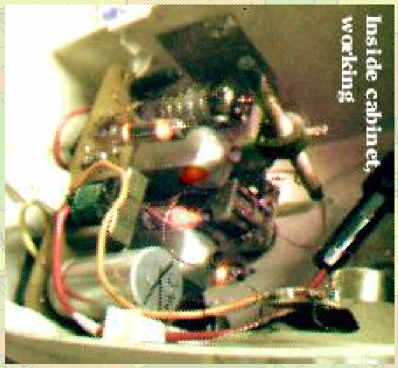


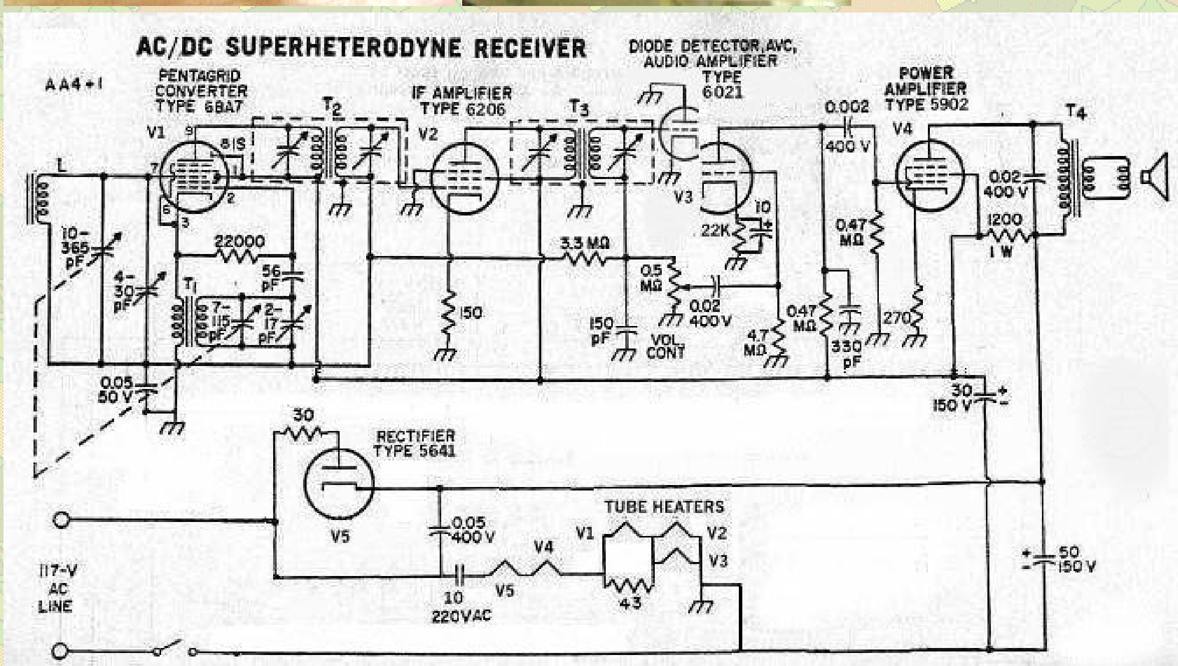
This completes the sub-mini tube AM radio. Aside for the 12BE6, is was pretty much a simple substitution of tubes. The third radio below replaces the 12BE6 with another miniature pentagrid converter tube, the 6BA7. This tube has 6dB more conversion gain.

Data sheets with curves can be found in PDF form for most of these tubes at: [Frank's web page.] Be aware that there is a daily download limit of about 4 megs at these sites.

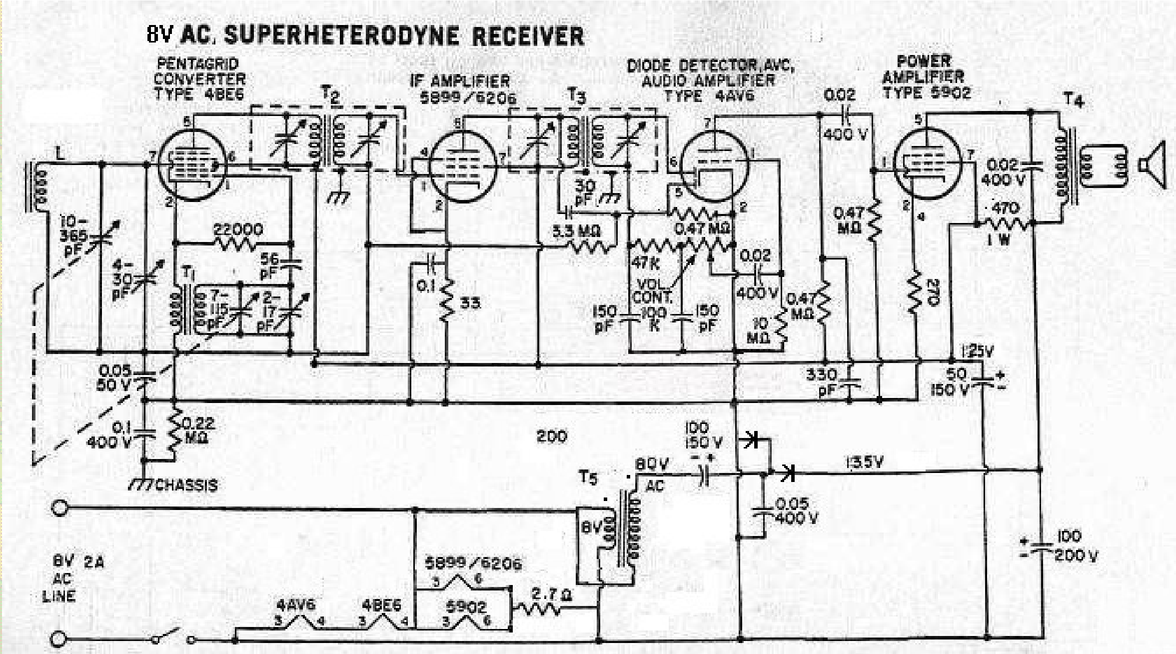
Yet another garden variety AA5 modified, 4 submini's and 1 miniature tube. A high conversion gain pentagrid converter tube (6BA7) is used for the front end, and the rest are subminiature tubes. 6206 IF amp, 6021 twin triode for the detector and first audio, 5902 audio out, and 5641 rectifier. Makes for a nice sensitive receiver. Note the lack of tube sockets, even for the 6BA7 miniature tube. File with a small file the tube pins to make them accept tinning for soldering.





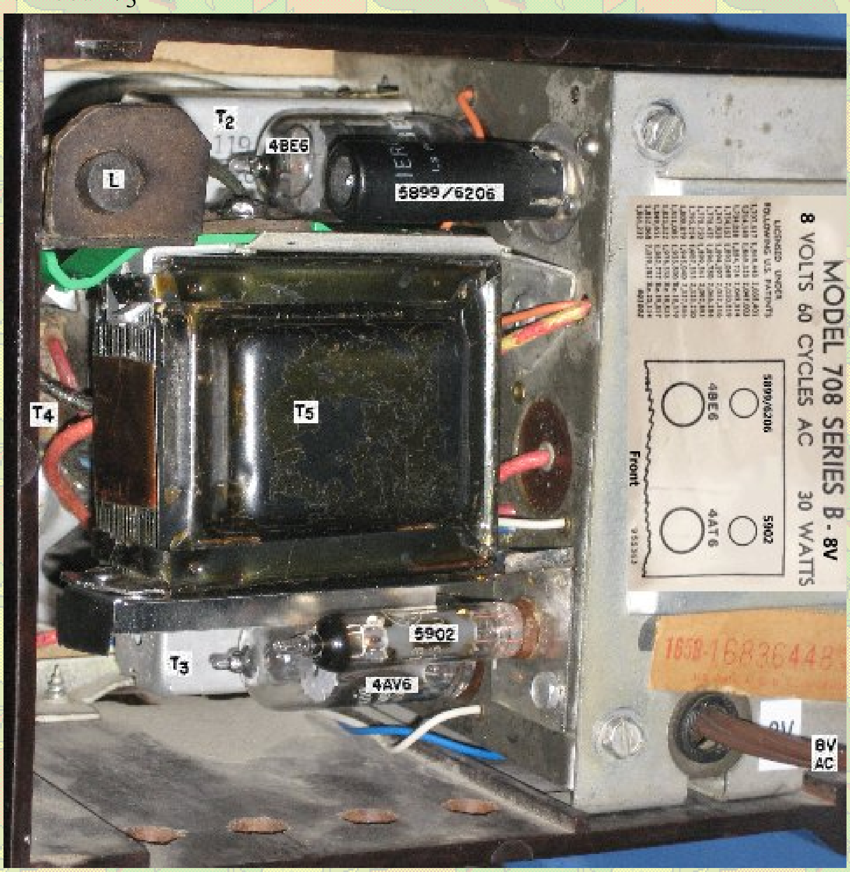


Yet another AA5 (an Emerson 708B) modified with some subminis and designed to run off 8VAC. Why 8V you ask? This dates back to my late 1960's model railroad days when I ran HO scale streetlamps off 8V instead of 14VAC, to prolong bulb life and make the lamps look more realistic. Built a 8VAC 5 amp bus for this. Still have it. Anyway:



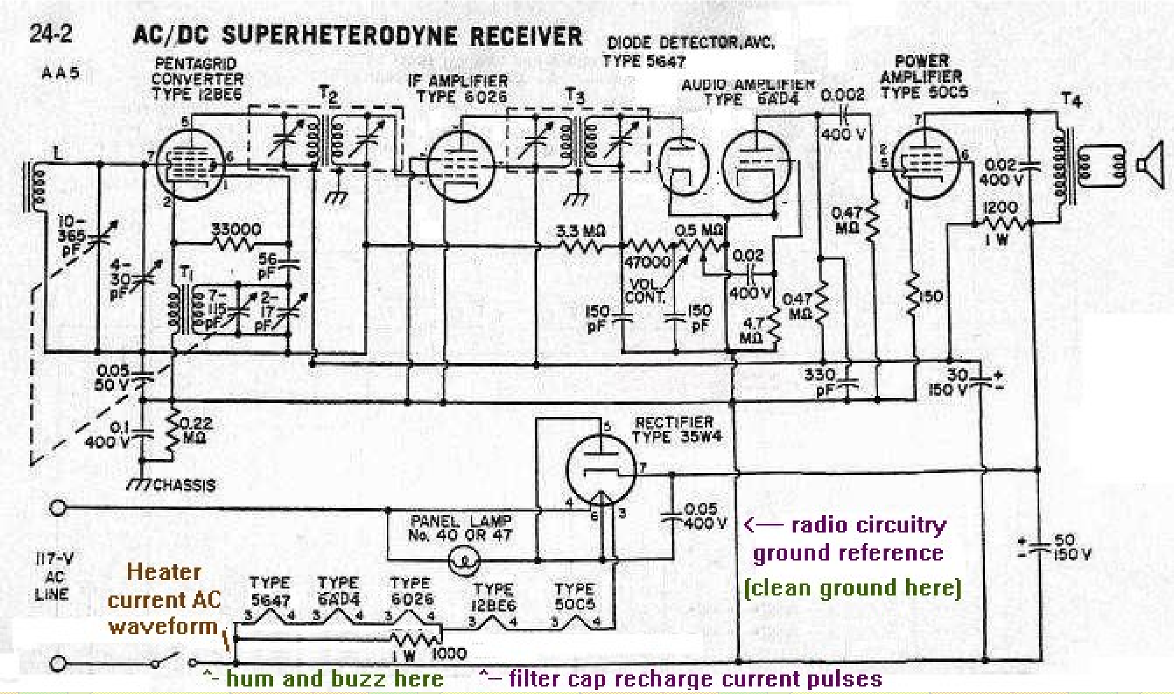
To get plate voltage I used a 110V to 12V transformer run in reverse 8V to 72V. And I connected the new 72V secondary atop the 8V line to get 80V (unloaded). Then voltage doubled it, though the secondary's resistance lets the resulting B+ sag to around 135V. The nature of the current filter cap recharge is that it looks like pulses with a duty cycle of around 5%. This radio's current draw on the B+ is about 40ma, and this combined with this 5% duty cycle makes for peak currents 20 times larger, here about 0.8A. And with the 72V secondary resistance of about 40 ohms that makes a loss of 32VAC. Subtract 32V off the 80V and that yields 48VAC, and with the voltage doubler (x2.8) that produces 134VDC. About what I measured. Secondary resistance is effectively multiplied, making it worse than you'd think.

You don't see this with hot chassis silicon diode rectifier power supplies, as American 120V 15A branch circuits have an effective resistance of about $\frac{1}{3}$ Ω.

What it looks like: 

I edited the tube placement chart, printed it out and glued it to the cabinet bottom. It's here as an insert in this picture.

More fun with submini tubes in a plastic GE AA5



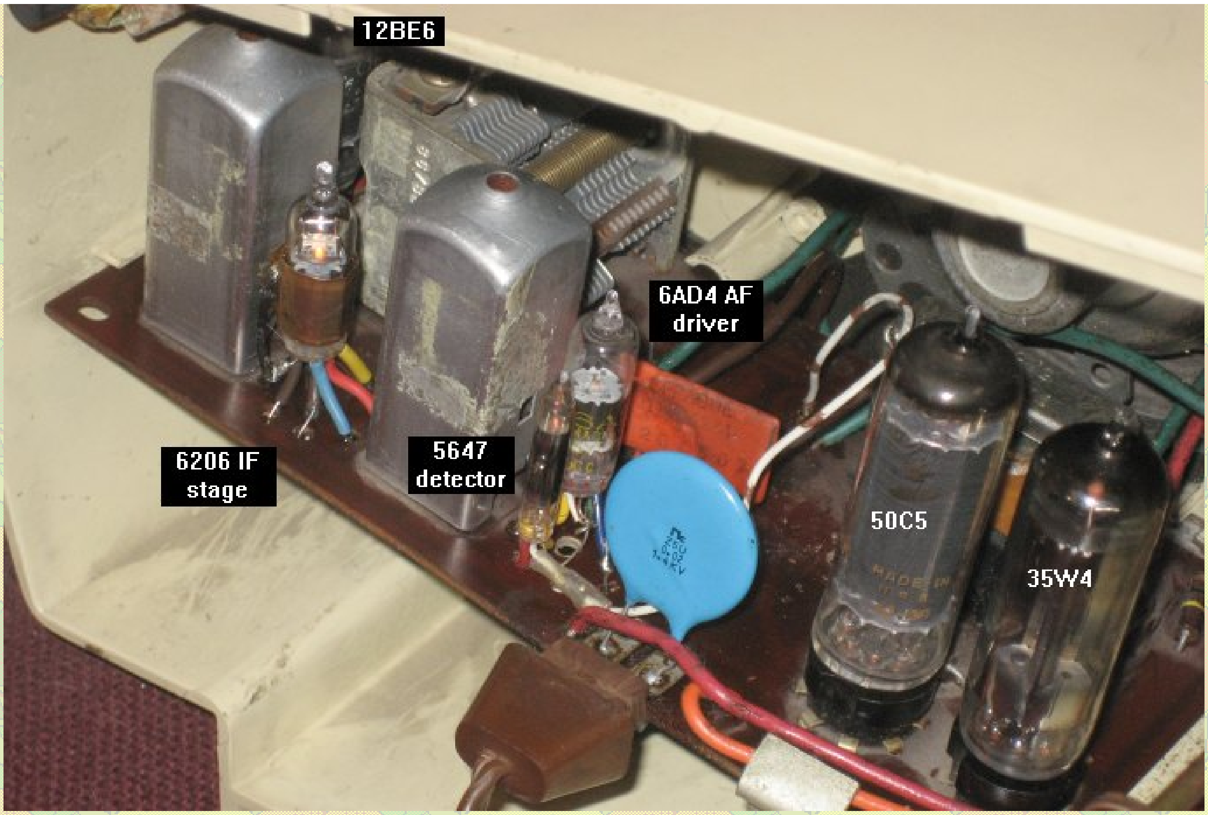
Here's a pretty common GE plastic AA5 clock radio, the C435A modified with a 6026 submini semiremote cutoff pentode for the IF stage, and a 5647 detector diode, and a 6AD4 triode for the audio driver in place of the 12AV6. I initially tried to gather all the tubes in one cluster (using subminis for the IF and audio driver and detector), to simulate a single tube "AA5" "Single tube "AA5" radio, what if?" as described in my web page , but the IF stage is rather fussy about unintended feedback. So I reworked this radio to place the tubes in their original locations, but substituting with the same subminis as mentioned.

Turns out the submin heaters consume a bit less current than their ratings state (150ma, seems they actually use about 130ma), so I added a 1K shunt to get the heater voltage more correct on the subminis.

The radio works quite well. It didn't work so hot with the tubes grouped together (the IF oscillated). Oddly enough, initially I forgot to install the AVC filter cap, and the radio worked, but was insensitive. Added that cap and got tons of motorboating. I then placed the same tubes in their original positions, no circuit changes other than that, and the radio works well.

For some extra grins, I changed the 22K resistor at the 12BE6 to a surface mount resistor I pulled off an old computer motherboard. It went right between the circuit board lands holding the tube socket.

Another thing worth mentioning is that the diode's heater is placed right at the ground end of the heater string, and I connected it via a wire jumper (that's the white with brown spots wire in the picture) to the point on the board where the switched powerline wire comes in. Idea is to avoid any AC heater currents from flowing thru the board grounds, to avoid hum inducing ground loops. This incoming point is where I also connected the negative end of the first filter cap, to also keep cap recharge pulses from inducing buzz into the board grounds. The "radio circuitry ground reference". as commented in the above schematic.



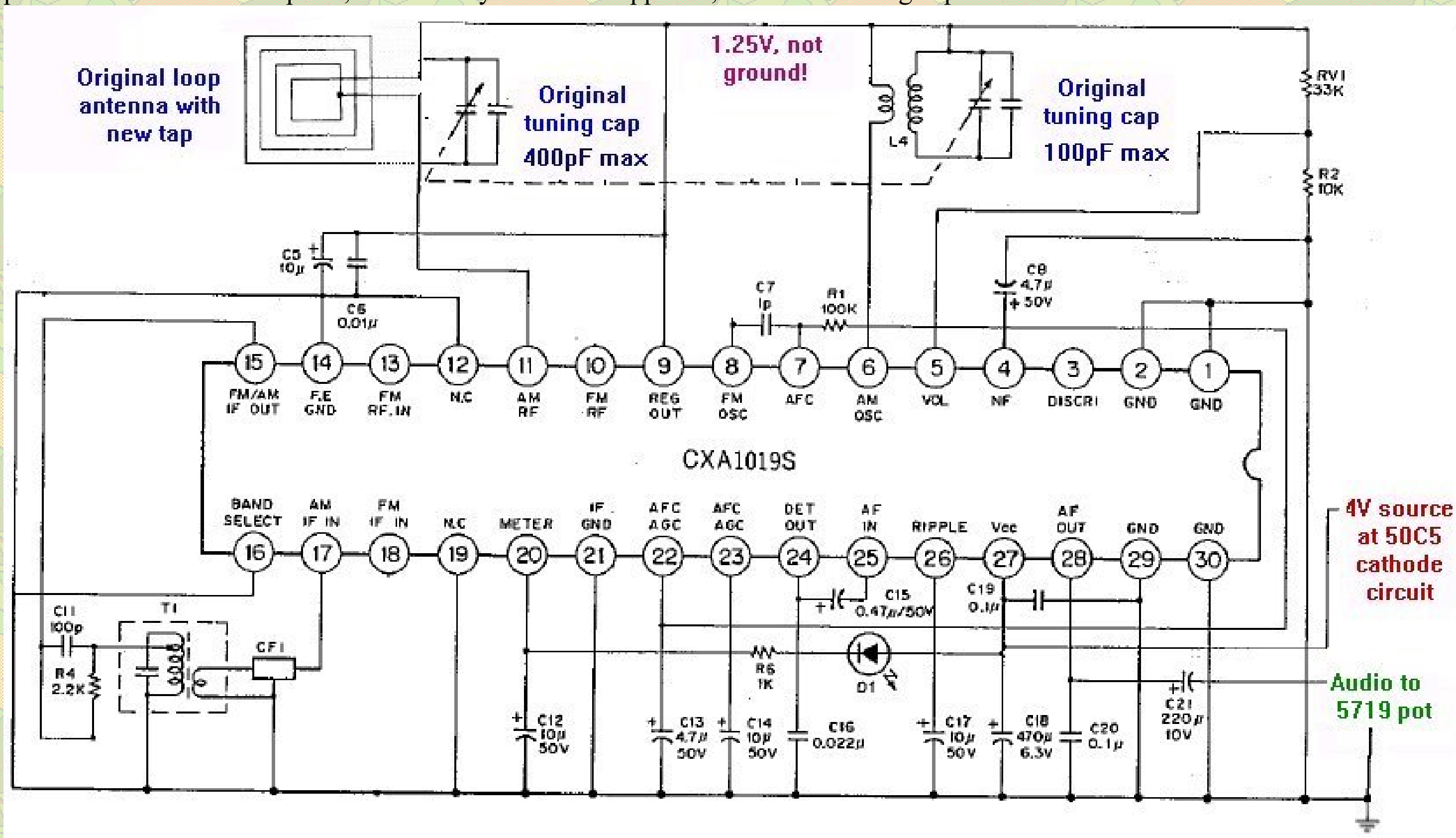
Modified a boring AA4 with a SS radio chip 

Had an Admiral AA4 radio, the kind that used an autodyne 12AU6 converter, no IF stage, and the usual 12AV6 50C5 and 35W4 circuits. It was insensitive, and it had a boring plastic cabinet anyway. So...

At a garage sale picked up a Sony AM-FM "transistor" radio that had a beat up cabinet. I figured I could use this radio's circuit board to replace the RF sections of the above AA4.

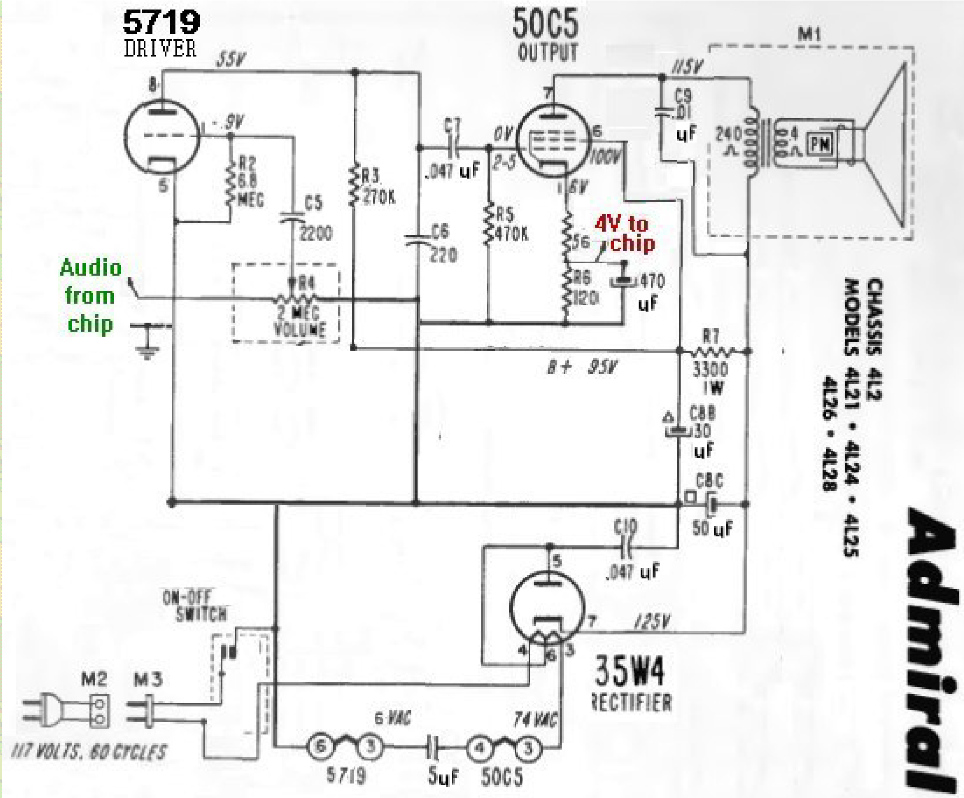
In step stages, I removed the FM specific parts from the SS board, making it AM only. Tested it to see if I broke something. Removed its tuning cap and measured it with a cap measurer. The antenna was 150uF max, and the osc 100uF max. The AA4's original tuning cap is antenna 400uF max and osc 100 uF max. This means I can use the SS board's osc coil, but tring to match the antenna tuning cap to the SS antenna needs work. Never did get satisfactory results, but I then decided I could make use of the AA4's loop antenna, and install a tap to feed the SS chip's AM antenna input. Looked at the data sheet of the chip, a CXA1019S and it had a spec for the AM antenna listing the number of turns for the LC circuit and turns for a secondary to feed the chip. Which gave me a turns ratio that I can then pick a point on the loop antenna to install a tap, ideally 22% but here at 20%, close enough. And this allowed me to keep the original loop and tuning cap to preserve the original antenna LC circuit. The osc tuning cap was very close, and the SS osc coil is adjustable, so mating the original tuning cap to the SS osc coil was no

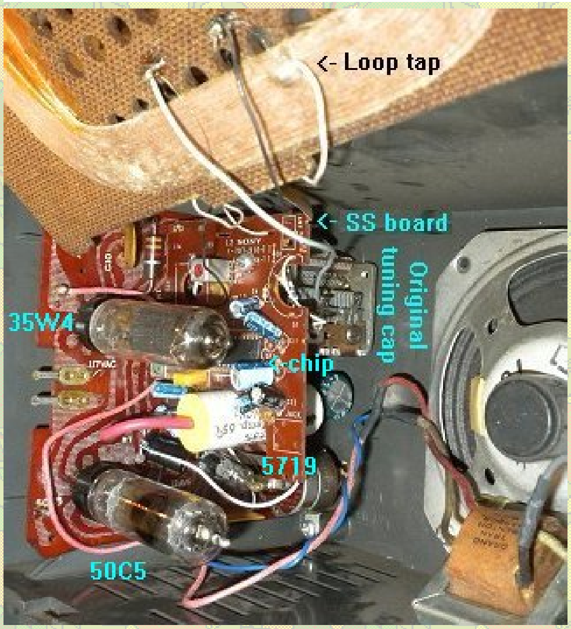
problem. Tested it at this point, to see if any mistakes happened, and to tune things up.



With this success, now it's time to merge this above chip to the audio driver (changed it to a 5719 submini tube, you may need to lower its plate resistor, I used a surface mount resistor in parallel to get it to 270K), output and rectifier tube circuits. Need a 4V power supply for the chip, which I can get from the 50C5 cathode circuit. This cathode runs around 6V, so I used a resistor voltage divider to get the 4V. And this divider lets me use a cap to filter the 4V to remove cathode follower induced audio. But still letting me have some cathode follower feedback for the 50C5. The chip's speaker output now feeds the AA4's volume control. The "transistor" radio's volume control I set to give me a reasonable level of audio to feed the AA4's pot, selecting a undistorted audio level, aka "line level" that you'd get from the old tube AM detector circuit. Used fixed resistors to replace its old volume pot, once I determined the setting of it.

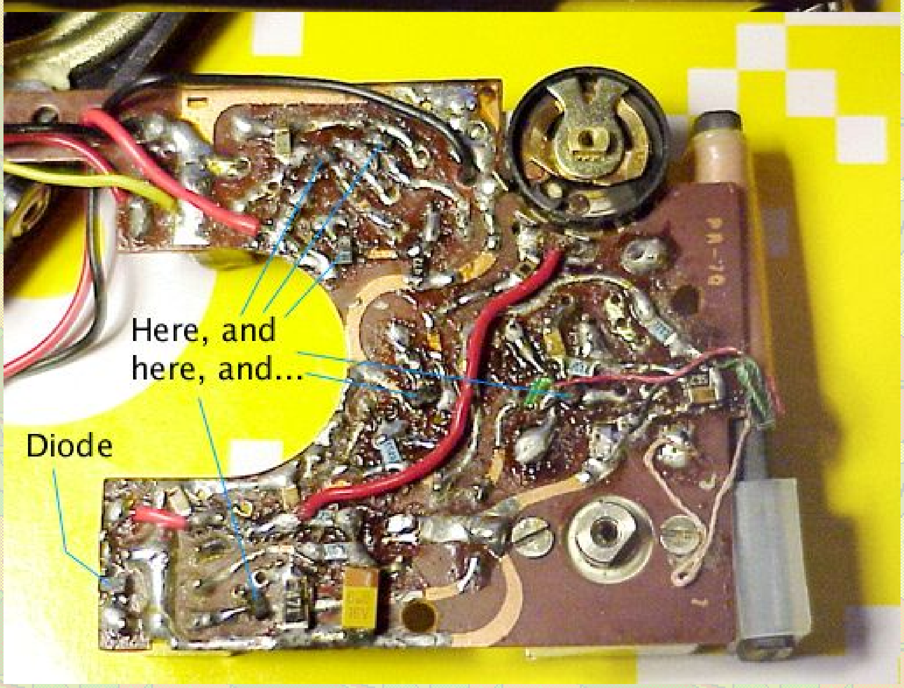
Used an AC voltage dropping cap (here a 5uF 220VAC rated) to drop the missing 30 volts of now missing heater. If you measure the AC voltage across this cap, you'd see around 78V. This AC voltage waveform is shifted 90º from what you'd see across the resistive heaters. The current waveform doesn't change phase, so the cap does not consume power. This saves 4.5 watts of heat inside the radio cabinet. This means the radio must operate off AC powerlines, but have you ever encountered DC powerlines in the past 50 years?

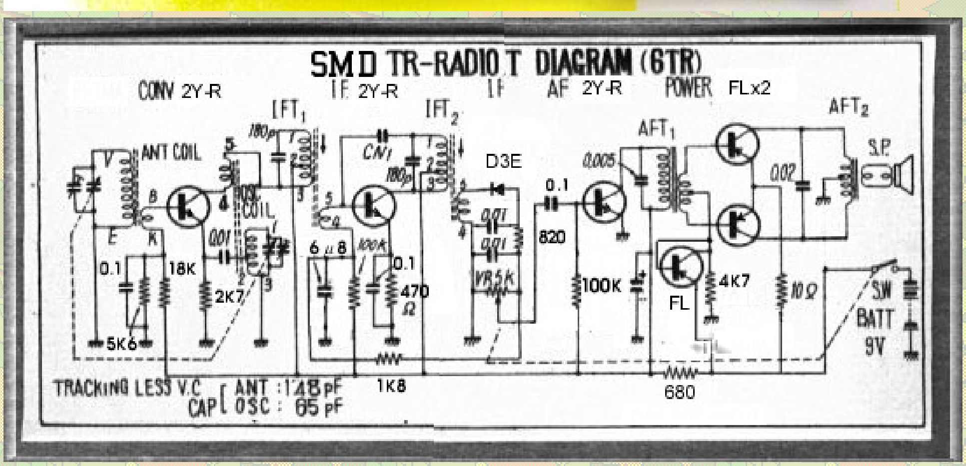




Packaged it up, and externally the radio looks the same as before, but it really pulls the stations in. And we still have AA5 tube sound.  I thought the heat from the tubes might cause the local osc LC circuit to drift (the square can with the red slug is the osc coil L, not that far from the 35W4), but this radio seems quite stable (no drift as it warms up, or when turning it on after many hours off it still brings in the station I had tuned in when the radio was warm when I turned it off). Note that the tuning cap and the loop antenna is now a low impedance path to the powerline, thru a 1.25V regulator circuit inside the chip. So be sure you can't touch it when the radio fully assembled, else you could take a shock and probably fry the chip.

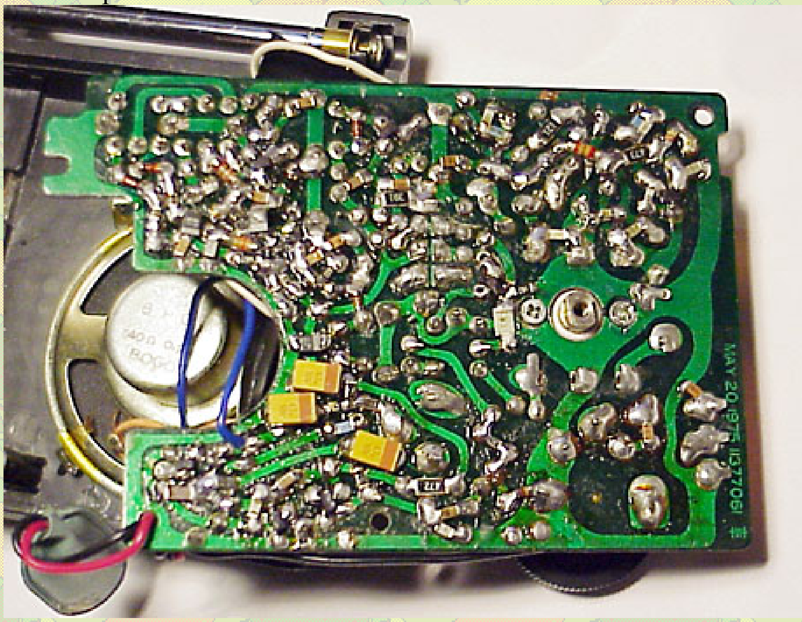
So much for submini tubes, how about "submini" transistors? SMD to be more specific:

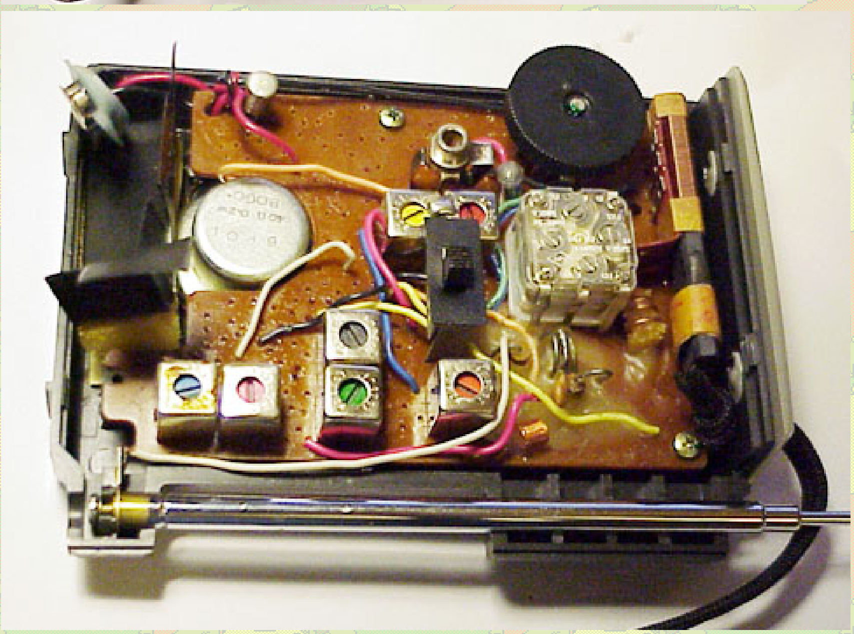




All these were scavanged off of defunct computer equipment boards. This radio is actually pretty sensitive despite only one IF stage. Also a Schottky diode (low forward voltage drop of around 200mV) makes a good detector.

And an AM-FM transistor. The only difficult part was finding a good FM mixer transistor. Ended up using one from a dead GHz cordless phone.





WE6W Resonant Speaker (N5ESE Prototype)

built by Monty Northrup, N5ESE

(More pictures and diagrams follow the narratives)

NOTE: 'N5FC' is my former call.
This project was constructed while that call was valid, and you may observe references to it.

On this page, we'll describe our prototype of the WE6W resonant speaker. I did **not** invent this device. In fact, I know very little about how it works. I recently ran across a description of it by the developer, Ed Loranger (WE6W). Click -here- for Ed's QRP-L post for this speaker, **which contains the instructions I used for building this speaker**. Ed tells me that an update design was finished but not yet generally available. I won't give his e-mail address here (at his request), but hopefully the information here will get you started.

I do not know enough about acoustics to offer any good formulas or explanations of why or how this thing works. You can check -here- for some basic formlas (sans acoustic theory). In brief, a resonant speaker is an acoustic filter with a speaker integrated into its structure. Signals applied to the speaker are reinforced and/or attenuated by the shape and volume of the device such that only certain "resonant" tones are produced efficiently. Ed's design here is one of the premier designs, because it provides a multi-order acoustic filter, with good stopband and steep sides. One version, much classier-looking than mine, can be seen -here-.

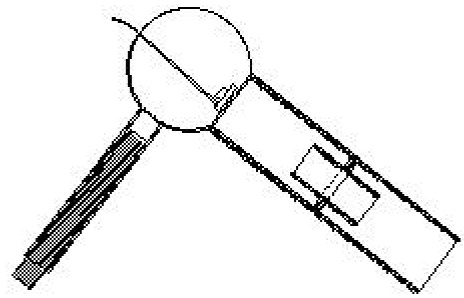
Ed tells me that the typical bandwidth is around 45 hertz, with resonances at the design frequency and odd-harmonics, and the stopband is at least 20 dB. I built three prototypes. All worked, all were useful, but all had some unexpected behaviors beyond what the designer described. The last version (Prototype 3) has narrower bandwidth and steeper sides than claimed by Ed.

A Request...

Ed has graciously allowed me to post his QRP-L description and a drawing of his concepts. An article in April 1983, QST provides more extensive background. An understanding of the design requires that you first read and study these carefully. Please don't ask me how to modify or amend it, or why yours works or doesn't work. I just won't know. Instead, post your results and questions to the **QRP-L mail list** or the **rec.radio.amateur.homebrew** newsgroup, for discussion and review.

If you *really* want to know *how it works* - without my bumbling experiments getting in the way of a thorough understanding - click -here-

Here's a sketch of the original concept (we'll submit our version/prototype later):



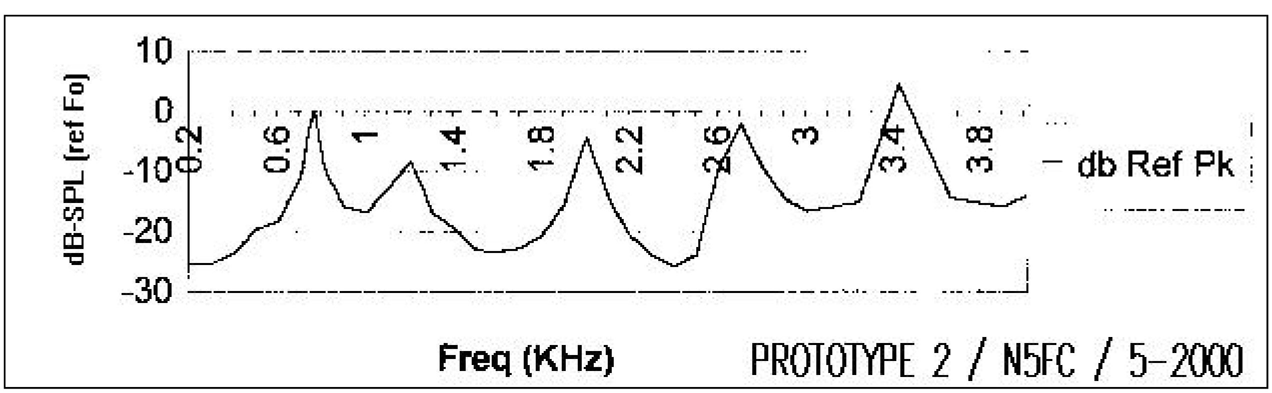
sketch in hi-res JPEG form [85K]
sketch in MS Word97 (200K, better printing)

The First Prototype

In my first attempt (which is 95% like the third and final version), I used a larger diameter inner tube (1.375 inch I.D. instead of the 1.1 inch specified by Ed). I also used a 1.375" O.D. speaker (instead of the specified 1"), thinking it was the cone diameter, and not the rim diameter that made the difference. While the speaker certainly worked, the local power-line hash caused serious ringing, and I was unable to attain the bandshape Ed claimed. Ed had stated that there were resonances at the design frequency and odd harmonics, but I had obvious peaks at all harmonics, although some were more prominent than others. I could not get a null at Fo + 100 Hz, but I was able to get a reasonable improvement by nulling the second harmonic. When I placed the inner tube/disc at halfway, I had a resonance at about 760 Hz, and adjusting the plunger to null the second harmonic, the plunger was about 1.5 inches recessed into the 6-inch tube. I asked Ed (via this e-mail message and this follow-up) for advice, and he responded with first this message, then this one. It appears I would need to use a 1-inch speaker (as specified by Ed), and shorten the inner tube to about 1.8 inches. I ordered the speaker (Kobitone Mylar/ Mouser 25RF006), but that would take some time to get. So I shortened the inner tube/disc combo to 1.75", and called it:

The Second Prototype

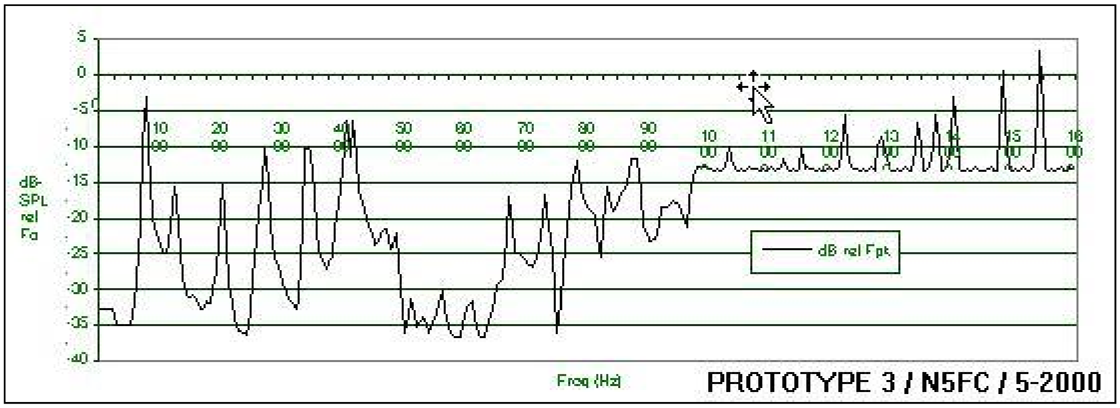
The version with the 1.75-inch inner-tube/disc, did not differ considerably from the first: It did not ring nearly as much as the first (with power-line hash), but it still had multiple peaks, with some at even harmonics. I took some measurements on this one, using a signal generator and a sound-level-meter on the bench. More questions to Ed regarding the multiple resonances brought this reply and this one. There was a lot of ambient noise in this setup, but I was able to create the following plot:



It was obvious I needed a little improvement, and the arrival of the 1-inch speaker from [Mouser Electronics] allowed better compliance with Ed's original design:

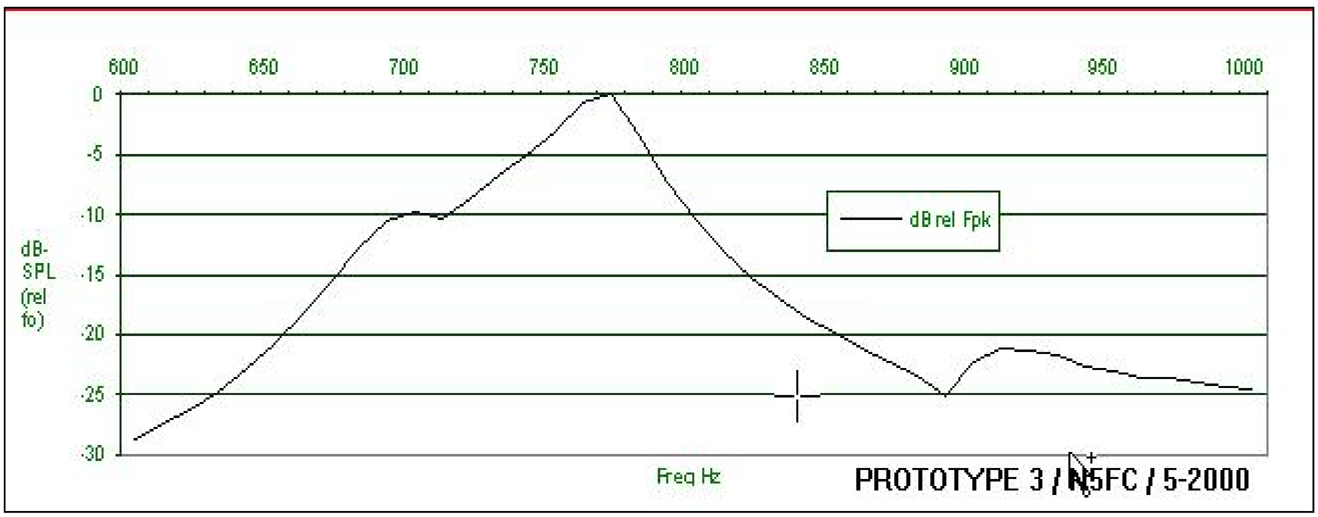
The Third Prototype

This is my current "as built". To test it, I took it to an acoustic anechoic chamber ("quiet room"), and used professional-grade measuring equipment. As a result, I am able to offer the following plots:



Or click: [Prototype 3 Speaker, 200-16,000 Hz] [JPEG for Hi-Res Screens, 83 Kb]
Or Click: [Prototype 3 Speaker, both plots] [MS Word97 document, 100 Kb]

The first plot, from 200 Hz - 16 KHz, shows that the peaks (both even and odd) are all still there, but they are somewhat reduced from the first two prototypes. With the replacement of the speaker, the tuning plunger worked fine at Fo + 100 Hz (actually, I used Fo + 120 Hz).



Or Click: [Prototype 3 Speaker, 600-1000 Hz] [JPEG for Hi-Res Screens, 83 Kb]
Or Click: [Prototype 3 Speaker, both plots] [MS Word97 document, 100 Kb]

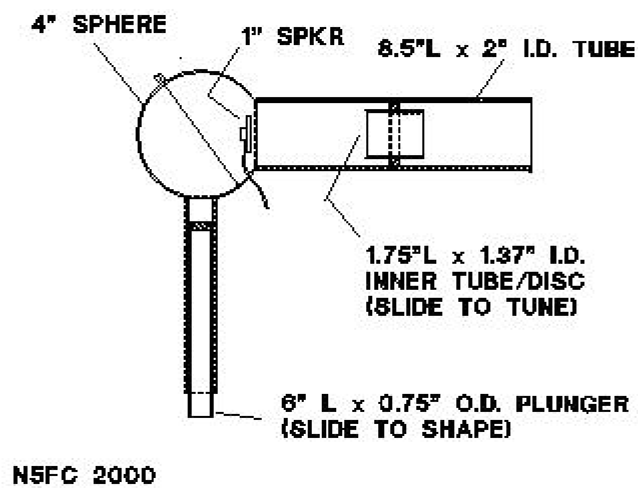
The second plot, an expansion of the first plot, focuses on the design frequency and its bandpass characteristics. As you can see from the plots, the speaker exceeds the designer's original claims, with 35 Hz 3-db bandwidth (as opposed to 45) and stopband more than -25dB down (at least near the design frequency). This version sounds great when used with a ham receiver, which already has a voice-bandwidth filter (and thus making the multiple higher resonances mute). Ringing is quite reduced from the first two prototypes, and the bandwidth is sharp enough to completely miss a weak signal unless you're dead-on (when all of a sudden, there it is!).

Construction Notes

Here, we'll offer details of construction of the third prototype. Mind you, the original designer (Ed, WE6W), informs me that the peaks occuring at 2 x Fo were unexpected, so there may be some construction anomalies in

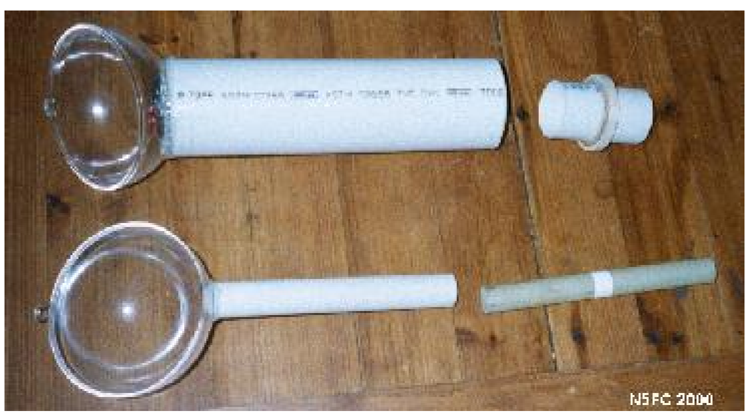
this prototype that contribute to that unexpected result. Still, in practice, the results are better than I expected.

Refer to the following drawings for dimensions and construction notes.



Prototype 3 Speaker, Sketch [JPEG for Hi-Res Screens, 60 Kb]
Prototype 3 Speaker, Sketch [MS Word97 document, 110 Kb]

We found a clear plastic sphere kit in the local "Hobby Lobby" crafts store. It came in two snap-together halves, which (surprisingly) were pretty tight. It also had a little hanger-loop on one side. I think it was intended as a base for a homemade Christmas ornament. We used a hobby knife, the blade of which was heated over a gas stove, and cut the 2-inch hole carefully in one half of the sphere, and the 3/4-inch hole in the other half. The holes were located such that the two long tubes would be at 90-degree angles, and the entire assembly could be hung from the ceiling on a coffee-cup-hook, with the main port pointing at the operating position (as shown in the image at the very top of this web page).



Or Click: same image, annotated, hi-res screens...same image, 640x480

We brought the speaker wires out through two small (and tight) holes in the sphere. To mount the tiny 1.05-inch speaker, we heated three 1-inch pieces of AWG 20 bus-wire, then quickly placed them in the plastic rim of the speaker, sticking out like 3 spokes at 120-degree intervals. Then we epoxied them in place, being extremely careful not to epoxy the speaker (hi). When dry, we bent and cut the speaker-mount "spokes" carefully, such that the speaker would mount about 0.15-inch inboard of the two-inch hole in the shere half, centered on the hole, and firing straight out of the hole. After it was properly positioned, we epoxied it in place. The speaker picture shown below is similiar, but for a larger speaker (prototype 1, which was later updated).

Or Click: same image, annotated, hi-res screens...same image, 640x480

Then the 8.5-inch x 2-inch I.D. PVC tube was epoxied in place on the 2-inch hole (sand and clean mating surfaces first), using clear, quick-set epoxy. Then the 6-inch x 0.75-inch tube was likewise epoxied to the other sphere-half. The wood ring was carefully drawn onto 1/4-inch thick basswood (available from craft stores), then cut so that it would fit snug (fairly) inside the 2-inch PVC tube, and *over* the 1.75-inch x 1.375-inch I.D. inner tube. The wood ring (disc, as Ed calls it) was epoxied to the 1.75-inch tube, about midway along its length. Because we weren't getting a real good seal between the 8.5-inch tube's inner surface and the wood ring, we fabricated a rubber gasket (out of a flat sink stopper) to fit down onto the wood ring, and provide a seal and friction against the inside of the 8.5-inch tube. Concerning the 6" plunger, we used a piece of 3/4-inch O.D. fiberglas tube (Ed recommends metal), and we applied a ring of teflon plumbers' tape around the outside at a couple of points, to provide a seal and friction when the fiberglas tube was installed in the 6-inch x 3/4-inch I.D. PVC tube. Check the pictures below (especially the "parts" and "overall") to better visualize what was done.

Tuning was simple. Keep the volume/gain very low to begin with, because it's very easy to overdrive this speaker and create distortion products. The speaker is very efficient and doesn't need much energy to do it's job, but you might be tempted to overdrive it if you're "off-frequency" from the peak. If you're using a ham receiver as your audio generator, tune to a fairly strong CW signal. Use the broadest filter you have with the receiver. (2.5 - 3 KHz would be ideal). Starting with the 6-inch x 3/4-inch plunger nearly all the way out, and with the inner tube/disc at the midpoint (along the 8.5-inch tube), adjust the frequency (pitch) of the CW to peak (mine peaked at 750-780 Hz). Keep in mind, the tuning can be very sharp, and you can easily tune right past it (especially if you've never used a 35 Hz filter). Once you've found it, tune 100-150 Hz higher in pitch and adjust the 6-inch plunger slowly inward until you hear a "null" (for me, this occurred with the plunger approximately midway). That's it! If you want a lower or higher pitch for your filter, adjust the inner tube/disc inward (higher pitch) or outward (lower pitch) until you get the desired frequency. The Jones filter on my Ten-Tec Scout peaks about 670 Hz, so I later adjusted mine for that frequency, at which point the inner tube's outer edge was flush with the outer edge of the 8.5-inch tube.

Summary, and My Impressions

I had a ton-of-fun building and measuring and tweaking this speaker. One thing I found I need in practice is a switch to switch back-and-forth between the resonant and broad-band speakers. With heavy power-line hash (as I frequently have in my metropolitan setting), the ringing can be bad enough to annoy. Once, I thought I heard a weak CW station, only to discover that my ears were playing tricks on me as the noise rang in the speaker. Also, the tuning is very, very sharp, and your receiver's tuning resolution (tuning knob rate) better be up to the job. On a crowded band, when you do get a weak station tuned in, the resonant speaker can make it seem like you and the weak station are the only ones on the band. It's amazing. One annoying little quirk, when using QSK, is that your sidetone (transmit tone) may be pretty much eliminated, if it's not inside the narrow passband of the filter.

Our thanks to Ed Loranger, WE6W for his help in getting this project going. Again, for further information and learning resources, he suggests esoteric literature, April 1983 QST, and a review of patents. Also, submit reports and inquiries to the QRP-L mail list or the **rec.radio.amateur.homebrew** newsgroup.

73, and have fun! -- monty

First, for viewing MS Word97 documents (and high-quality printing):

WordView97

Pictures and Diagrams:

Resonant Speaker, Overall view [hi-res screens, 145 Kb]
Resonant Speaker, Overall view [640x480 screens, 60 Kb]
Resonant Speaker, hanging from ceiling [hi-res screens, 81 Kb]
Resonant Speaker, , hanging from ceiling [640x480 screens, 56 Kb]
Resonant Speaker, parts, exploded view [hi-res screens, 120 Kb]
Resonant Speaker, parts, exploded view [640x480 screens, 56 Kb]
Resonant Speaker, speaker mount, wrong speaker [hi-res screens, 123 Kb]
Resonant Speaker,speaker mount, wrong speaker [640x480 screens, 68 Kb]
Resonant Speaker, sketch, WE6W original design [JPEG, hi-res screens, 85 Kb]
Resonant Speaker, sketch, WE6W original design [MS Word 97 document, 200 Kb]
Resonant Speaker, sketch, N5ESE Prototype 3 [JPEG, hi-res screens, 85 Kb]
Resonant Speaker, sketch, N5ESE Prototype 3 [MS Word 97 document, 200 Kb]

Other Online Resources:

Dave, N5IW, Resonant Speaker Page (simpler design, lower-order filter)

Return to N5ESE home page

Overseer: Monty Northrup ... e-mail ... leave e-mail ...

maddog homepage Visit our regular (non-ham, but very popular) homepage

White LED Inverter
White LED voltage converter

The article describes a simple and very cheap inverter for white, blue or UV LED, usable for example in small lamps and testers. Component costs do not exceed 10 CZK.

The inverters for white LEDs have been described quite well on the pages of professional journals. When I needed a similar converter recently, I wanted to use a transistor with a transistor. However, this inverter was not well suited for the required supply voltage range (2 common cells). The solution would be to use a specialized integrated circuit, but the converter should be as cheap as possible. So I have tried some of the published plugins of simple converters plus a few others. But I was not very satisfied with anybody. Some inverters have a performance that is suitable only for demonstration purposes, others have little effect. Several authors promised to stabilize or limit the output current. Although such a transducer really did not increase the LED current from a certain voltage, this "stabilization" was caused by the saturation of the collector current of the transistor or the overpressure of the choke. For higher voltages, the efficiency of the drive quickly diminished.

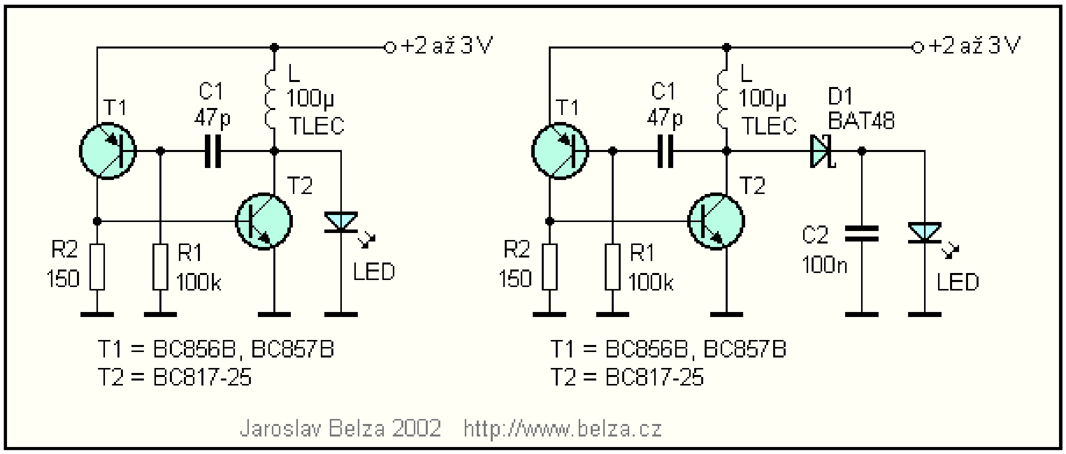


Fig. 1. Simple converter for white LEDs
Figure 1. Simple and cheap voltage converter

I have therefore proposed a simple connection in two variants, which is in Figure 1. In the original circuit I replaced one resistor with a capacitor and optimized the values of the components. The inverter does not have any current stabilization, but it does not matter when it is powered by two NiCd or NiMH batteries because their voltage does not change much for most of the discharge time. The inverter is in two variants - with and without a rectifier. Experimenting with classic components was a more advantageous option with a rectifier. The inverter was more efficient. However, in the final design with SMD components, the relatively small resistance of the small Schottky diode (BAS85) was negatively impacted, while the efficiency of the inverter without the rectifier was greater, probably due to smaller parasitic capacities.

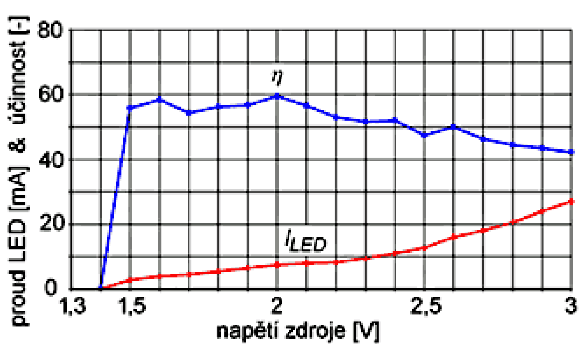


Fig. 2. Equivalent LED current and converter efficiency without rectifier (BC558B and BC639 transistors used)
Figure 2. Efficiency & equivalents LED current - circuit without rectifier

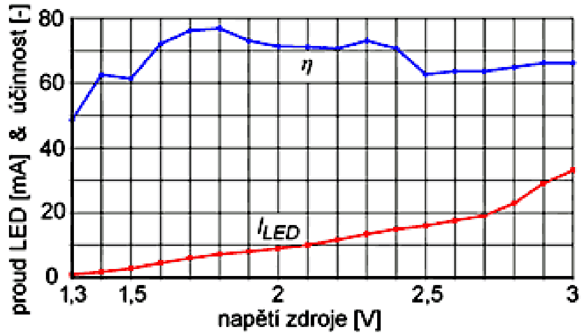


Fig. 3. Equivalent LED current and efficiency of the inverter with rectifier (BC558B, BC639 and diode 1N5818 used)
Figure 3. Efficiency & equivalent LED current - circuit with rectifier

The efficiency of the drive can be increased by about 10% in both variants by using a better coil with less winding resistance. A low-cost TLEC miniature thrust choke was used in samples (in GM electronic for CZK 3). The LED current can be adjusted by changing resistance R1 (greater resistance, less current) or capacity C1 (greater capacity, less current) For a 1.5 V supply voltage, reduce the resistance R1 to 18 to 22 kiloohms.

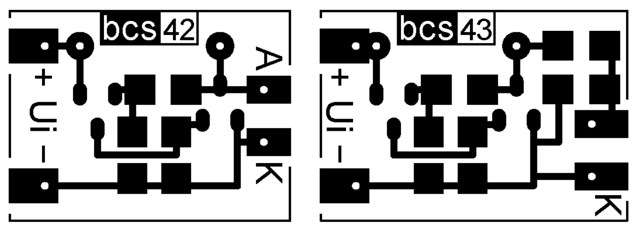


Fig. 4. Controller circuit board. If you use the right mouse button and select "Save image as", you get a link template at the 600 dpi
Figure. 4. PCB layout. Click right mouse button and choose "Save image as" to get 600 dpi resolution image

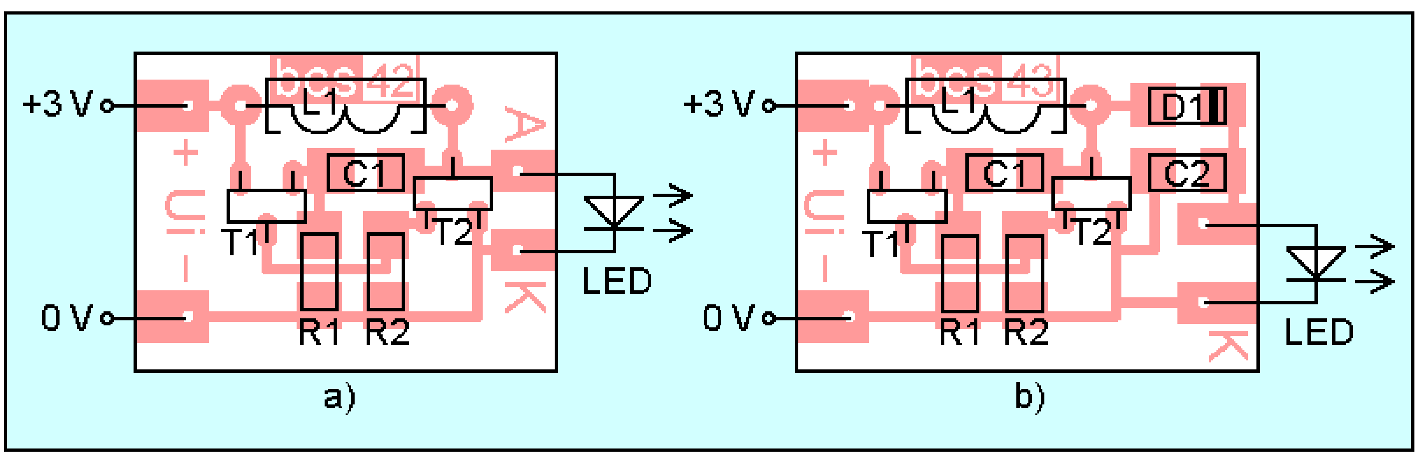


Fig. 5. Placing components on the board
Figure 5. Locations of components on the board

Measurement of efficiency

Measuring the efficiency of similar drives is always a bit of a problem. The supply voltage is impulsive or wavy. Connecting the meter to the LED series greatly distorts the results because the meter has a voltage drop of several hundred millivolts. I therefore measure the effectiveness indirectly. I plugged the LED into a short black plastic tube, I placed a 10 kiloohm resistor photodiode (BPW43) against the LED. At the inverter I measured the voltage and current on the photodiode for each supply voltage. In the next round, I set the same DC voltage and current on the same LED, with the same voltage on the photodiode. I calculated the power from the drive power and the LED power (ie drive power).

I am aware that even this method can not be accurate. The LED powered by DC 20 mA will not light up like the same LED powered eg 1: 1 pulses with 40 mA current. In addition, the measurements in Figures 2 and 3 are subject to the inaccuracies of the measuring instruments - it is necessary to measure three quantities at the same time and do not have so many digital multimeters. The old handset came to the word, which was rather inaccurate at the end of the range.

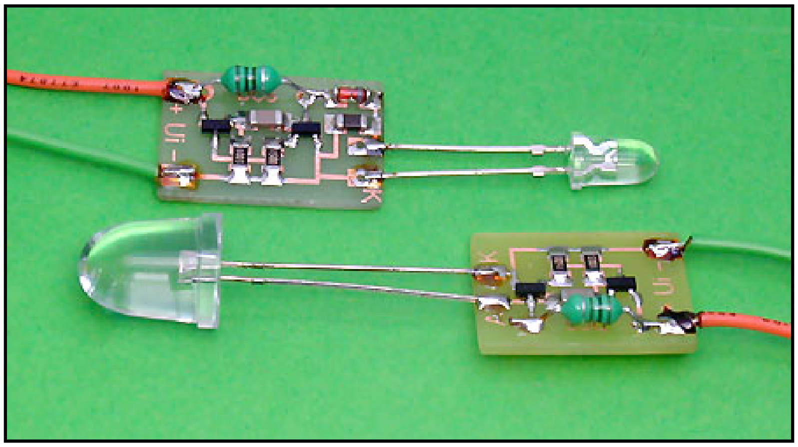


Fig. 6. Sample Photos of the Drive
Figure 6. Converters photo

Jaroslav Belza

Inverter connection was printed in PE 1/03
And still look here , so if you know Hungarian

4. 8. 2003 upd.
4. 12. 2002

BELOW are my original, very crude and totally unedited 1986-1989 notes and "raw data" for Electricity Exhibit, written for the Museum of Science in Boston. Some of this material became finished articles on Amasci.com.

Why are my explanations different than usual? Because they're not based on earlier K-12 textbooks. Instead they're based on college-level physics textbooks, but I've translated the math into English. They're also based upon the intentional defeating of misconceptions: on the painful 'unlearning' I had to go through before I could gain an intuitive understanding of simple electrical physics. I kept a running record both of textbook errors and of useful simple concepts, as well as listing my own childhood misconceptions as I discovered them.

[PS These notes are from before internet, before email, with many written on a typewriter and on a "word processing" system with no italics available, and most were transcribed before www and the <i> tag. No, the all-caps below is not shouting. This was written well before the "all caps is shouting" email standard. The all-caps in this document are actually notes to future publishers to typeset italicized words. Since apparently this opens up the material to straw-man troll attacks and accusations of angry shouting, I've added the italics tags. -billb 2015]

See also:

- MAIN INDEX: Articles "Electricity"
- Electricity FAQ: Frequently Asked Questions
- INDEX: Electricity Misconceptions

WHY IS ELECTRICITY SO HARD TO UNDERSTAND?

A collection of various ideas. [LONG!]

(C)1995 William Beaty BSEE

In 1986-1988 I was working on Holt/Rinehart "Science" (their K6 text,) and also designing electricity devices at Boston's Museum of Science.

I began slowly collecting instances of wrong electricity explanations. Most were misconceptions being spread by the current crop of K6 (grade school) science texts. Others were in mags and newspaper articles. A few were even in dictionaries and encyclopedias. The more I found, the more sensitized I became, and the more I could "see."

In addition I began mining my own head for misunderstandings I originally had as a beginning learner. I couldn't get inside students' heads, but certainly I could get inside my own student brain of long ago. As I slowly learned new ways to understand the subject, I kept discovering new ways in which I'd *mis*understood it myself, and I kept adding to the growing pile. The misconceptions list became large, and soon I also was discovering parts of electricity that the general public invariably found misleading, or parts that were universally explained badly even in physics textbooks. (Advanced texts get the math right, but sometimes the rest of the explanation is faulty.)

Below is the result. It's my big pile of raw unedited notes. Here's the finished product. Someday I'll try to include all the hand-drawn diagrams as well. (The edited condensed version is here" Bad Physics: common electricity misconceptions.)

Why is 'electricity' nearly impossible to understand? Because of...

SCROLL DOWN

UP TO: finished electricity articles

1. PROBLEMS CAUSED BY THE DEFINITION OF THE WORD "ELECTRICITY"

Why is electricity nearly impossible to understand? Because of...

...wide misuse of the word "electricity." Using Electricity as the single name for several completely different substance-like quantities, while at the same time expecting students to extract each differing meaning of the "electricity" from the way we use it in explanations. Unfortunately, students instead become permanently confused because they don't realize that the word has several definitions. They hear one word and assume we're talking about one single entity. As a result, they hear us describe a single "electricity-stuff" having contradictory, confusing, totally impossible behavior.

...because we misuse the word "electricity." Using it to name physical entities and also classes of phenomena. Students may end up believing that static, current, electrons, and protons are various types of energy! (This is like confusion over the difference between Geology and rocks, or thinking that "Biology" and "living tissue" must be the same thing.)

...we misuse "electricity" in early grades, then we never point out our earlier misuse during more advanced grades. Students end up with misconceptions learned early on. We use "lies to children" to avoid complicated explanations, but then we're never up-front with older high-school students about the misconceptions they probably acquired in grades K-6. Why can't we specifically teach kids about this problem with the definition of the word "electricity?"

...because of our ignoring the contradiction between descriptions of various "kinds" of electricity. We insist that there are *only* two kinds of electricity, pos and neg electricity! Then we say no, there are *only* two kinds, static and current. Then we say no, there are many kinds of electricity: it's a *class of phenomenon* with many types, like Bioelectricity, Piezoelectricity, etc. And then: no, there is *only one* kind of electromagnetic energy, and electricity is a form of energy, therefore there's only one kind of electricity. ...All these statements are both right and wrong: when used alone they are accurate only because "Electricity" has so many distinct definitions. But because these statements contradict each other, collectively they become a serious error.

...because of "simplifying" a number of distinct concepts by collecting them under the single name "electricity," with the result that students come to believe in a nonexistent stuff called "electricity" which has contradictory, confusing, and impossible characteristics.

...because we lack rigorous dedication to truth and clarity, instead there's a cover-your-tail attitude where the confusing presence of multiple definitions of "electricity" in dictionaries is used to legitimize contradictory use of the word in classrooms. Rather than fixing the problem in classrooms, we point to the confusion in dictionaries and insist that the classroom problem is acceptable! But just because a dictionary records the various contradictory definitions, this doesn't constitute an authoritative approval of their use by teachers.

...because we use the physics-term "quantity of electricity" to legitimize other misuses of the word "electricity." Physicists use the word "electricity" in a very narrow sense, but does this mean that all *other* definitions are OK? But "quantity of electricity" means just one thing: it means charge, measured in coulombs. In other words, physicists actually say (indirectly) that it's *not* correct to believe that electricity many other things besides coulombs of charge. They're saying that electricity is *other* joules of energy, electricity is *other* the flow of electrons, or classes of phenomena, etc. They're saying that electricity means "charge," and other definitions are popular meanings, not scientific ones.

...because of mistaken belief that "electricity" travels one way in wires, going from source to load... and at the same time believing that it travels in a circle and all returns to the source, without any being used up.

...because of mistaken belief that "electricity" travels at the speed of light, while at the same time it flows along at inches per hour as the electrons travel slowly in metals.

...mistaken belief that "electricity" alternates: flows equally back and forth at 60HZ, while at the same time it flows continuously forward from source to load.

...mistaken belief that "static electricity" is "electricity" which is static and unmoving.

...mistaken use of familiar terms with unfamiliar definition causes confusion. For example, in electrical science "AC" does not mean "alternating current". Instead it means something akin to "having changing value." So a constant voltage is called "DC" even though it's not a current. And a changing voltage is called "AC," and the term "AC voltage" is commonly used. Does "AC voltage" mean "Alternating-Current-Voltage"? No, that would be silly. AC voltage is changing voltage; DC voltage is unchanging voltage. An "AC signal" may be entirely composed of electrostatic fields and have nothing to do with current, even though we call it alternating current "AC." But if you believe that "AC" means only "Alternating Current", you will be confused by electrical explanations written by the experts.

...wrongly assuming that students are as adept as their instructors when it comes to manipulating concepts. Some instructors know that "electricity" has multiple meanings, and therefore we must take the word in context to see what the intended meaning is. But students don't know this, they think we're using a single word, and so must be discussing a single concept. We end up convincing them that a single entity called "electricity" exists which has confusing, contradictory attributes.

...textbooks start with basic assumptions about "electricity," and then expand on these. But if the basic assumptions are never critically examined, they may or may not be correct. (Example: K-6 books assume that a single substance-like entity called "electricity" exists. Another: there are only two kinds of "electricity.")

...invisible war between old and new definitions of "electricity." The word was originally used to mean "electric fluid." As the concepts became refined, the Electric Fluid changed into "charge," so a quantity of electricity was simply a quantity of charge. But in recent decades the word has been usurped by electric companies, and now usually means "energy." But this leaves a gap, since "electric fluid", or stuff-flowing in-wires now has no common name. The word "charge" is often used instead, but this is misleading, since a wire can have zero net "charge" even while there is flowing charge within it. Even more often, the word "current" is incorrectly used instead of "electricity", as in "flow of current" (but a current is a flow. Are rivers full of current? No, water. Flow of "charge" is correct, flow of "current" is not.) But lots of older literature still contains the older definition, and it states that "electricity flows inside of metals." Modern authors may unknowingly take older explanations to heart and believe that they were discussing energy, not knowing that the older works were discussing an entirely different "electricity" than is found in modern texts.

...incorrect popular conceptions of electricity which must be unlearned before accurate concepts can ever be understood.

...mistaking the wave for the medium. Is "electricity" the electrons, or is it the wave of electron-flow, or is it energy that flows THROUGH a column of electrons. Think of how difficult it would be to understand sound waves and air pressure if we had just a single word that meant both "sound" and "wind" and "air."

...mistaken belief that "generate electricity" means "create electrons."

...belief that a single "electricity-stuff" flows in circuits, when actually there are several different types of "stuff" which can flow: the charge flows slowly around a circuit, while energy propagates from source to load at high speed, while net-charge and current also propagates fast in various directions. Charge flows down one wire and back up the other, while energy flows down both wires and does not return.

...mistaken belief that electric current is charges flowing inside wires at the speed of light. The charges actually flow at inches per hour.

...mistaken belief that net charge and charged particles are synonymous. However, a wire can have no net charge, yet its mobile electron-sea can flow. An "uncharged" wire which has equal amounts of protons and electrons can contain a huge electric current. Is there "charge" inside the wire? But the wire has no "charge!"

...mistaken belief that "current" and "static" are substances. The only substance here is electrons and protons. They cause the phenomena called "static" (electrons separated from protons) and "current" (groups of electrons moving in relation to groups of protons). "Static" and "current" are events. They are happenings, not substances.

...mistaken belief that a phenomenon is "made of electricity," when the phenomenon is really just "electrical." If we say that lightning is "atmospheric electricity", then we mean that it is an electrical phenomena, and should then never say that lightning is "a type of electricity," or that it is "made of electricity". Doing so would be like saying that clouds are "composed of weather," and the little droplets in a cloud are made of a liquid called "weather."

...mistakenly confusing electrical phenomena with electrical quantities. Lightning is "electricity" because it is an electrical phenomenon. But lightning is not electrical energy (the energy actually flows *into* the lightning bolt from the surrounding space) and lightning is not electric charge (the lightning can strike much faster than the electrons move, and the flowing electrons often move in the opposite direction from the direction of the lightning strike) So, lightning may be "electricity," but in the same way that batteries and bulbs are also a form of "electricity": they both are electrical.

...belief that there are only two types of electrical phenomena: static electricity and current electricity. In fact, there are many many others. Lightning is Atmospheric Electricity (and since it involves both AC and DC, electrostatics and electric current, it could also be called Impulse Electricity.) Heart-muscle phenomena is Myoelectricity. Then there's Piezoelectricity, Triboelectricity, Contact Electricity, Bioelectricity, Photoelectricity, ...

...mistaken belief that "static" and "current" are opposites. Yet pressure is not the opposite of flow. The opposite of Static (or separated +- charge) is not Current (or flowing charge.) The opposite of Static is canceled charge; neutral matter. The opposite of *moving* canceled charge is not separated charge, it is *unmoving* canceled charge.

...mistaken belief that electric energy flows *through* an appliance and returns to the generator. Only the charges do this, not the energy. The appliance acts as an energy absorber.

...mistaken belief that energy flows out of a battery through one wire, then flows back through the other. The charges do this, while the energy flows along *both* wires in one direction, from source to load.

...mistaken belief that, in an AC system, electric energy vibrates back and forth. It is the charges, not the energy, which vibrates like this. The energy flows forward continuously. It's like waves on water, or sound in the air: the medium wiggles as the wave-energy proceeds forward.

...wrongly describing the presence of electric current as "electricity" and the lack of current as "no electricity," when actually the flowing charges which cause the current are present whether they move or not. Analogy: when water stops flowing in a pipe, the water doesn't disappear. And when an electric current is halted, the charges remain in the wires, which is the place where they started.

...little use by educators of the wind/sound electrical analogy:

- AIR is a physical substance.
- SOUND is a wave that propagates rapidly through a volume of air.
- WIND is a flowing motion of air already present.

1. ELECTRIC CHARGES are a physical substance.
2. ELECTRIC ENERGY is a wave that travels via a column of charge.
3. ELECTRIC CURRENT is a flowing motion of the charge already present.

The confusion between charge-flow and energy-flow is similar to confusion between wind versus sound. Do you know that sound is not wind? To believe that electrons flow at the speed of light is similar to believing that air must travel at 720mph out of your mouth to distant ears.

UP TO: finished electricity articles

2. PROBLEMS CAUSED BY WIDESPREAD STUDENT MISCONCEPTIONS

Why is electricity impossible to understand? Because of...

...student misconceptions which over the years have managed to invisibly infect textbooks, and reference books, and even educators.

...widespread assumption that textbooks are nearly 100% accurate. This causes us to be overly trusting of textbooks, and so we ignore any slow increase of errors in the books. It makes us

unknowingly spread the authors' misconceptions. When we do notice misconceptions, we either remain in denial about them or we minimize their importance. Our assumption that textbooks contain only minor flaws causes us to be threatened by anyone who points out serious errors or attempts to correct them. Lack of a critical viewpoint leaves textbooks wide open for creeping "infection" by increasing amounts of misconceptions.

...widespread assumption that textbooks are nearly 100% accurate. We remain in denial that they are imperfect, and this keeps students in the dark about the need to take all textbook assertions with a grain of salt. It hides from them the need to constantly examine themselves for the presence of misconceptions. As a consequence, they may never learn that hard work is required to assemble and *create* their knowledge. Instead they end up sitting back and being spoon-fed a group of disconnected, possibly misleading facts. If we stop uncritically accepting the contents of books, we might finally become aware of the necessity of learning concepts rather than memorizing facts.

...widespread assumption that textbooks are nearly 100% accurate. This keeps students from complaining about bad textbooks and teaching. If curriculum materials are assumed to be perfect, the fault must lie with the student. But if they could instead always regard curriculum materials with a critical eye, they might demand improvements.

...assumption that student misconceptions always arise mysteriously within the students, when in fact these misconceptions are often specifically taught in earlier grades. E.g.: the constant current battery misconception. In grades K-6, kids are hammered with the concept that batteries are sources of "current electricity." High school physics teachers then complain that the kids believe that batteries always put out the same current regardless of the load. The solution isn't to figure out better teaching methods in highschool physics, the solution is to send a million complaints to the publishers of the misleading K-6 curriculum materials!

...textbooks lack discussion of common flaws and misconceptions. Books tell us all about electricity concepts, but never go into detail about possible conceptual pitfalls to avoid, and don't expose us to the idea that the recognizing and eliminating of misconceptions is a powerful learning technique. They don't stress the fact that the *wrong* answers are of tremendous value, that wrong answers shouldn't be punished or hidden away in embarrassment.

...avoidance of discussion of misconceptions in the classroom. Common misconceptions aren't specifically attacked in school. If learning cannot progress until a misconception is UNlearned, then a student with a misconception can waste years in futile attempts to progress. Talented kids may needlessly abandon physics as "too hard," when the fault actually lies with their distorting "mental filter" created by an unexamined misconception. (E.g.: when kids believe that current is a substance, all accurate info on electricity will be interpreted under this assumption. As a result it will be twisted into useless garbage, while periodic textbook assertions that "current flows" will keep reinforcing the students' misconception.)

...students blaming themselves. Electricity is thought to be abstract, complicated, confusing, mysterious, and invisible, with behavior which frequently goes against common sense, and anyone who can't understand it has just not worked hard enough. No. In fact, electricity *explanations* are contradictory, confusing, needlessly abstract, and frequently go against reality and common sense. But students who have difficulties understanding them will not blame books

and instructors, they will put the blame on themselves. Therefore no one will feel any need to improve the situation.

...mistaken belief that the understanding of electrical physics only involves the memorizing of right answers, and that the concept-networks, the *storytelling* part is not important. This allows us to blithely teach sets of contradictory concepts, since each concept may be accurate when examined on its own. Example: electricity travels at nearly the speed of light (yes, this is true if "electricity" is defined as meaning "EM energy.") Example: electricity is composed of particles called electrons (yes, if "electricity" is defined as meaning "charge") But the student will never grasp electrical physics now, because these two concepts turn to garbage when combined.

...explaining things in certain ways because it is traditional to do so, rather than explaining things in certain ways because it gets the concepts across well. "That's the way everyone does it, so it must be right." "All the textbooks do it this way, and that many books cannot be wrong." This is the "Fox Terrier Clone" problem described by Stephen Jay Gould. E.g.: we always say that "current flows" out of battery, through lightbulb, back to battery. Why not alter this to read: charge comes out of *lightbulb,* is sucked into the battery, flows through the electrolyte, gets spit out of second battery terminal, then flows back to the bulb? That's more enlightning; more correct. But the distorted traditional explanations muscle their way into all textbooks and wipe out creative improved models.

^ UP ^

OTHER ARTICLES:

- True direction of "current"
- Slow speed of electricity
- Current versus "static"
- Current versus "charge"
- Visible Electricity: red and green plastic
- Are amperes fundamental?
- All articles

UP TO: finished electricity articles

3. PROBLEMS INVOLVING THE "ELECTRIC CURRENT" CONCEPT

Why is electricity impossible to understand? Because of...

Because most book and textbook authors believe ...that Electricity is the flow of Electricity. (What?) They think that "Electricity" appears whenever Electricity flows in wires? That whenever Electricity starts flowing, this flow is called by the name Electricity? Yep. Or put more simply, authors themselves have little grasp of the difference between amperes and coulombs; between current and charge. They talk as if electricity is a thing that flows inside of wires, then they turn

around and say that electricity is the flow of something else inside of wires. It's as bad as being confused about the difference between air and wind, or the difference between the flow of river water versus the water itself. (Is electricity something like water, or is it something like the flowing motion of water? Look in K-12 textbooks. You'll never pin them down to one clear position, instead they switch back and forth.)

It's impossible to grasp because books continuously state that "current flows." (This is connected to the mistake above.) If an author tells us that "current" is a stuff that flows along, then this tends to convince us that a substance-like entity called "current" exists. And it wrenches us away from any use of the Charge-flow concept. (Physicists know that electric current is a flow of charge, but read K-12 textbooks and see what language they use: not "charges flow," but instead "flow of current.") We can easily test for this mistake in any book or piece of written text. Just mentally replace their word "current" with the phrase "charge-flow" to see how it reads. Most explanations will then wrongly teach that "charge flow flows," and they'll speak of "flows of charge flow." Some books even say that an electron is a tiny piece of "charge flow." (No, electrons are particles/carriers of charge, not carriers of "flow.")

...mistaken belief that generators and batteries send out a "substance" or "stuff" called "current" to appliances. (In reality, electric current is a flow of the copper's own charges. Currents are not like a substance which can move.) This error is connected to the mistaken belief that there is no path for current *through* a battery or generator, so that the "current-stuff" can only be supplied by the battery. (In reality the charges do flow *through* the battery and back out again. If the flow-path did not go through the battery or generator, then that would constitute an 'open circuit,' and all currents in that circuit would cease.)

It's impossible to grasp because of the mistaken belief that, since batteries and generators *cause* electric currents, they must be *producing* a substance-like material called "current." Or, since batteries and generators cause a flow of "electricity," we wrongly assume that they must be *creating* an electricity-stuff. In fact, the flowing charges were already in the wires to begin with, and batteries/generators simply behave as charge-pump devices. If electricity is like the rubber of a drive belt, then batteries and generators are like the drive-wheel which makes the belt move in circular fashion.

It's impossible to grasp because of the wide use of a confusing phrase "amount of current." No, current is actually a rate, not a substance-like quantity. Instead we should be careful to say it this way: "what's the rate of current," or "intensity of current", or "what is the value of current."

It's impossible to grasp because early textbooks wrongly mix the concept "quantity of a substance" with concept of "flow rate of a substance." This mistake occurs not only in electricity. Does a shower use lots of water? Meaningless question, since the length of time is not given. Or, is a high current actually a flow of "lots of electricity?" Meaningless, since it's the amount electricity flowing *per second*, not just electricity flow. Is a 1000W lightbulb a user of "lots of energy?" Meaningless. A 1000W bulb uses energy at a *greater rate* than a smaller bulb. If I turn on a small bulb for a year, versus a large bulb for a microsecond, the small bulb uses way more energy.

It's impossible to grasp because of incorrectly stating that electric current is the "amount of electricity," rather than "amount of electricity per unit time." "Amount of charge per unit time" would be a better way to say it, of course!

It's impossible to grasp because of the mistaken belief that devices which cause currents must be the sources of the flowing charge. (No, it's the wires which supply the charge which flows.) Mistaken belief that generators "supply current" (i.e. charges) rather than simply pumping them. This idea is supported everywhere by the incorrect terms "source of current" and "current carriers," which should more clearly be written as "cause of current" and "charge carriers."

It's impossible to grasp because of taking electric current as a fundamental entity, when charge is actually the fundamental entity (maybe done because of the N.I.S.T. ampere-seconds physical standard.) This wrongly diverts us from exploring deeper concepts involving electric current as flow of electric charge.

It's impossible to grasp because of mistaking the high-speed chaotic vibration of electrons for the low-speed motion during electric currents. (analogy: learning that air molecules individually move very fast, and then wrongly concluding that the earth must experience constant hurricane winds.) In fact, high speed air molecules imply HOT air. But the hot air is unmoving. And the high speed of electrons in metals acts like thermal vibrations; like heat in the metal object, and is not an overall motion or electrical current.

It's impossible to grasp because of the mistaken belief that all electric currents are flows of electrons. They aren't. This connects with the misconception that "electricity" is composed only of electrons. As a result, we tend to ignore the common non-electron currents in electrolytes, in semiconductors, nerves, the ground, oceans, batteries, corona, etc. In a battery, since only charged atoms are flowing between the plates, and since no electrons flow there, we may end up thinking that the path of electric current cannot be through the battery. In fact the path is through the battery. This "electrons are electricity" misconception destroys the whole concept of "electric circuits", since we mistakenly assume that batteries are open circuits. Wrong! A battery is a closed circuit, because if it was like an open switch, then battery-powered circuits could not even exist.

...mistaken belief that "electricity" obeys strange quantum-mechanical rules, and therefore "electricity" must be very different than normal matter. This connects with the incorrect belief that "electricity" is made of electrons. But while electrons do display significant QM behavior, electric charge in general does not. Circuits can be built using saltwater hoses full of flowing atoms. If one believes that only electrons are important, or that protons and ions can never flow, then one may mistakenly believe that the strangely enlarged quantum-mechanical behavior of the low-mass electrons proves that *all* currents and quantities of charge are weird and Quantum-y. In reality, electric currents don't have significant QM features, only *electron* currents have these features. True, electrons are so low in mass that they sometimes behave as waves, and their motion in metals is very far from the classical views of physics. But ion-based electric currents are very common phenomena in everyday circuits, and ions are massive enough that their QM behavior is vanishingly small. Many of the purported quantum-characteristics of electric current vanish when currents take place in tubes full of electrolyte. Electrons may behave strangely, but this doesn't mean that charge in general behaves strangely. Electrons may vibrate chaotically at the speed of light in metals, but this doesn't imply that "electricity" does this inherently.

...mistaken belief that no charge flows through batteries. (No electrons flow through them, therefore there cannot be current?) This leads to the traditional incorrect flashlight-current explanation (current comes out of battery, flows...etc.) It also leads to the misconception that batteries *supply charge*, and have a storage place for "used" charge. This might make sense if we

believe that there's no path for charge through the battery. But it's wrong, because there is a path, a path provided by flowing charged atoms. Charge must flow around and around a circuit, passing *through* the battery over and over.

...educators never employ the convenient fact that the rate of charge flow is proportional to charge speed within a particular wire. This greatly clarifies electric circuit concepts. High current is *fast* charges. Zero current is *stopped* charges.

...wrongly describing a conductor as "something through which electricity can flow," rather than as "something which contains movable electricity." A vacuum is a perfect insulator, even though it offers no blockage to moving charges. But a vacuum contains no movable charge, so it insulates.

...backwards introduction of electric flow vs. electric substance. During teaching, electric current concepts are often explored first, then electric charge is introduced later if at all. As a result, students think they understand Amperes, and they have little grasp of Coulombs, and in fact they may not really grasp either concept. Students end up thinking that the Amp is a fundamental unit; they ignore the Coulomb-per-second, and are confused by the Amp-second. The situation should be reversed: they should learn all about the Coulomb, hear about current only in terms of Coulombs per second, and should see the Amp-second as a strange, roundabout way of saying "coulombs."

...mistaken belief that since physics defines "quantity of electricity" in terms of ampere-seconds, quantity of electricity must somehow involve current rather than charge. No, its just that physicists in a Standards lab can measure charge flow and time more easily than they can measure net charge. It makes more sense to measure charge, then define the current as the flow of charge. Instead, the system of electrical standards first defines the current, then defines charge as a current which is on for a certain length of time. It might not make sense, but a Standards lab is after measurement accuracy, not sensible pedagogy.

...everyday electrical energy sources operate in constant-voltage mode, not constant current mode. We could say that they supply "voltage," not current. A battery is not a supplier of "current electricity," it instead supplies voltage, and various currents are *drawn* by placing various resistances between the battery leads.

...mistaken belief that batteries and generators are sources of current, when, since they are actually constant-potential systems, they are actually sources of "voltage."

^ Up ^
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4. PROBLEMS INVOLVING ELECTRIC ENERGY

Electricity is impossible to understand because of...

...mistaken belief that electric energy is not in the electromagnetic spectrum, even though it is composed of electromagnetism. Mistaken belief that electrical energy is fundamentally different from the rest of the types of energy in the Electromagnetic spectrum. Mistaken belief that DC or 60Hz energy is "electricity," while higher frequencies are "radio."

...mistaken belief that power is a substance-like entity which can flow. Power is actually a *flow* of a substance. "Power" means energy-current. Energy can flow, and its rate of flow is called power.

...mistaken belief that electric energy is made of small particles called electrons. Actually, the fundamental unit of electrical energy is the photon, not the electron, since electrical energy is electromagnetic field/wave energy.

...mistaken belief that energy flows up one wire, through the appliance, then back down the other wire. Energy actually flows up both wires, dives into the appliance, and is converted to other types of energy (heat, motion, etc.)

...mistaken belief that electric companies sell electrons. They actually sell 60Hz "radio waves", and only use the columns of electrons in the wires to transmit the waves to the end users.

...mistaken belief that energy flows inside of wires. Electrical energy is actually electromagnetic fields. It exists as the voltage field and magnetic field which surround the wires. Electrical energy flows as a "tube" which encloses a pair of wires and exists only outside the metal.

...assumption that electrical energy is an abstract quantity which can be ignored, rather than viewing it as the EM-wave energy which is sold by electric companies.

...backwards conceptual construction of power vs. energy during teaching. As a result, students think they understand Watts, none have a good grasp of Joules, and in fact they don't really grasp either concept. Students think the Watt is a fundamental unit, they ignore the Joule-per-second, and are confused by the Watt-second. The situation should be reversed: they should learn all about the Joule, hear about energy flow before learning that energy flow is the same as "power," and should see the watt-second as a strange, roundabout way of saying "joules."

...mistaken belief that individual electrons in wires carry energy along with them as they flow. The situation is really like that with sound: the energy moves as waves through a population of particles.

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5. PROBLEMS INVOLVING ELECTROSTATICS

Electricity is impossible to understand because of...

...mistaken belief that "static" and "current" are opposites. Yet pressure is not the opposite of flow. The opposite of separated charge (static) is combined charge (matter.) The opposite of moving canceled charge (current) is unmoving canceled charge (matter.) Pos and neg charges which are separated from each other, are not the opposite of pos and neg charges which flow relative to each other.

...mistaken belief that "static electricity" is "electricity" which is static and unmoving, rather than separated and "pressurized."

...mistaken belief that when "static" begins to flow and turns into "current," all the electrostatic phenomena must vanish.

...mistaken belief that when electrons and protons of matter are separated, they become "static" and unmoving.

...mistaking e-fields for 'static electricity,' as in: "Teacher, is the 'static' on the surface of the balloon, or is it in the space surrounding the balloon where my arm-hairs are standing up?"

...mistaken belief that "static" precludes "current" and vice versa. Actually, separated charges can be made to flow, such as in high-voltage transmission lines, and so we can have "static electricity" that flows. Conversely, when an electric current is stopped, the suddenly-unmoving charges do *not* constitute "static electricity", since there is no net charge.

...mistaken belief that "static electricity" is caused by friction, when it actually arises from charge separation.

...mistaken belief that "static electricity" only refers to dryer cling and scuffing on carpets, when in its other guise it really involves all circuitry. It's other guise is voltage.

...mistaken belief that since rubbing fur on a balloon produces electrical effects, it must be *producing charges*. We should put much more emphasis on separation of charge, and cut out any talk of "creating charge." Charges can be created, but it takes a particle accelerator or a radioactive source to do so.

...lack of an electrical term analogous to "magnetism." E-fields are then left out of early teaching because "electricism" is not an independent topic. When a compass aligns itself, that's magnetism. When hairs align themselves in an intense, distantly generated e-field, what's it called? Not "static electricity," because the strong charge is far away.

...significant emphasis is put on teaching of magnetic fields early on, but e-fields are not taught until more advanced levels. (In grades K-6, the e-fields are hidden within the "static electricity" concept and never specifically discussed.)

...lack of early teaching of the important e-field concepts. This causes the "voltage" concept to be seen as complicated and abstract, as involving mysterious meter measurement which have no connection to anything visualizeable. Yet "voltage" is "e-field", and we can draw pictures of it!

...mistaken belief that "static electricity" is caused by the static-ness or stillness of the charges. This causes the whole charge-separation concept to never be explored.

...electrostatics is skimmed over or ignored completely, yet in large part electrostatics is a study of "voltage." Skip over electrostatics, and your students will forever after be partially confused about voltage.

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6. PROBLEMS INVOLVING "ELECTRIC FLUID" ANALOGY

Electricity is impossible to understand because of...

...mistakenly believing that electric circuits are analogous to open hydraulic systems (pouring a cup of water through a pipe) when they actually behave like closed hydraulic systems: a drive-piston connected to a driven piston, with the connecting hoses pre-filled with water. This probably comes about in part when we teach that circuits are like pipes with water, but students then imagine the faucet at home, rather than the hydraulic system of a backhoe.

...mistaken belief that the fluid analogy does not apply to circuits because in wires the *energy* flows, while in pipes the flow is of a material. Mistaken belief that the "fluid" in wires always flows at the speed of light, while in pipes the flow can be fast, slow, or stopped. Mistaken belief that the "fluid" in wires flows from the source to the load and does not return, while in pipes the water circulates around and around. This is all incorrect. Actually the "electric fluid" in wires flows slowly, not at the speed of light, just as happens in water pipes. In wires, the "electric fluid" flows slowly while the energy flows fast, just as happens in water pipes. And in wires the "electric fluid" flows slowly in a circle, just as happens in a pre-filled hydraulic system.

...the lack of a good name for "canceled charge." When + and - come together, the result is *not* nothing. The result is matter. The result can also be the canceled-but-mobile "electric fluid" found in all conductors. Since matter contains (is even *made* of) "canceled charge," and since electric current in wires is a flow of "canceled charge," we should see matter as being made of "non-moving electric current." Matter is made of "frozen electricity." The exception is conductors, which contain "liquid electricity." Some common names for the neutralized mobile charges found in conductors:

- Electron sea
- combined charge
- canceled charge
- mobile charges
- mobile ions
- current carriers
- carrier population
- electric fluid
- Total Electrification (jc maxwell)

...early teaching about current, yet without teaching about the "substance" which flows. We shouldn't teach about "current" until *after* we've taught the "electron sea" concept. It's like learning about ocean currents without ever learning that water exists. It makes "current" seem needlessly abstract and non-visualizeable.

...mistaken belief that Ben Franklin's one-fluid theory of electricity was correct, and the two-fluid theory was wrong. In fact, matter contains pos and neg charges, or two kinds of "electricity." Ben thought that pos. and neg. was a surplus or deficit of a single sort of electric fluid. Not so, because

matter turns out to be *composed* of positive and negative particles, so there are two kinds of electric-stuff after all.

...mistaken belief that early theories of "electric fluid" were struck down, and so "electric fluid" does not exist. Ancient experimenters believed in electric fluid, but today we know better? No. Today we know that wires contain canceled, mobile charges. Today this is called the electron-sea of the metal, but "electric fluid" is not an incorrect way to describe it.

...misleading explanations of conductors and insulators. Instead of saying that conductors allow current, and insulators prevent it, say that conductors contain mobile charges, while insulators contain immobile charges.

...misleading explanation of a conductor as a material which passes electrons. Incorrect, since a vacuum offers no barrier to electrons, yet vacuum acts as a good insulator. The difference is that a vacuum contains no mobile charges, so when a potential difference is applied, no current results. A metal conductor doesn't pass electrons, instead, a metal conductor contains movable electrons.

...mistaken belief that electric current is a flow of energy, when it is actually a flow of matter. (our beliefs about energy tend to make us avoid ever teaching the fact that electric current is a matter flow.)

...use of the term "current carriers." This connects with the mistaken belief that current is a fundamental entity, rather than seeing charge as fundamental, and seeing current as simply a flow of charge. After all, we wouldn't say that the water molecules in a river are "water current carriers". Wires are full of mobile charges, not "current carriers."

...misleading description of wires as "hollow pipes." Ex: wires conduct electricity, metals conduct charge. Saying it this way covers up the fact that metals *contain* vast amounts of mobile charge already, and it paints a distorted picture of the situation. Better to say "the canceled charge inside metals is mobile," or "the charges found in wires can be made to move."

...mistaken idea that electric charge in metals is gas-like and easily compressible. Actually, the canceled charge within wires is fluid-like, very difficult to compress, and energy can be transported very rapidly (rigid rod analogy.)

...little use by educators of slow-electron-flow concepts. Ex: electrons flow like the minute hand on a clock, and if they were to flow fast enough that you could see a movement, that wire would be heated white hot by "friction." The electric fluid acts like tar: it stops instantly when the pressure is removed, gets hot from friction when forced to move, never moves very fast, large flows require huge pipes, small pipes are subject to very high friction, and fast movement always implies immense heating.

...mistaken "empty pipes" analogy. Wires actually behave like pipes full of water, with no *bubbles anywhere*, so when more water is pushed into one end, water immediately flows from the far end.

...mistaken "swirly water" analogy. If water is injected into a bowl, it just makes the mass of water flow in loops, and we mistakenly believe that the same holds true within pipes. But in a pipe, if

more water is injected into one end, the entire column of water advances as a unit, as if it were a solid rod. In pipes, water behaves like a solid drive belt.

...mistaken belief that since electric current is invisible, the charges in an electric current are also invisible. Little use by educators of the convenient fact that electrons are visible. "Electricity" is always said to be invisible, yet the mobile charges within wires constitute a silver liquid. The milk in a glass bottle may never be seen to move when stirred (no bubbles!) but that doesn't mean that the milk itself is invisible.

...little use by educators of the drive-belt analogy. Electric circuits are like pulley/belt systems, the electron-sea within a metal wire is like the rubber belt. When one part is moved, the whole thing turns, when one spot on the belt is clamped, the whole thing stops, no rubber or electrons are consumed, the belt moves slow in a circle while the energy moves fast in waves, the belt is not invisible and neither are the charges, back-and-forth motion sometimes works better than continuous rotation (AC vs DC), friction causes heat and even light, pulleys can drive or be driven (motor/generator duality), pulleys are not a source of rubber and batteries are not a source of electrons, and when the belt or the circuit is stopped, the rubber or electrons stop in place and forever remain. And belt-systems were in actual use until supplanted with generators and wires.

...the discovery of the electron is mistakenly interpreted as suggesting that electric fluid does not exist. This is analogous to a mistaken belief that the discovery of water molecules implies that water is not a liquid. Electrons and protons are fundamental particles of the electric fluid, in a similar way that the molecule is the fundamental particle of a macroscopic material fluid.

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7. PROBLEMS INVOLVING ELECTRIC CHARGE

Electricity is impossible to understand because of...

...misuse of the word "charge," using it both to refer to a charge of energy (capacitor, battery) and a quantity of electric charge. A "charged" battery contains just as many electrons as a "discharged" battery, because batteries store their energy as chemical fuel, a battery is simply a chemically-fueled electron pump, and is "charged" with chemical fuel, not with electrical energy. A fully charged battery contains the same net electric charge as a discharged battery. (yet it contains huge amounts of matter, which is made of charge!)

...the word "charge" is used to refer to net-charge and to canceled-charge. Students will see "charge" as following conflicting rules, yet their instructors act as if no conflict exists. But there is a conflict: an object with zero net charge is still full of charges, and an uncharged object will behave very differently that will empty space (ex: heating of neutral metal by induction, while empty space is not heated even though it is neutral.) And fast waves of net-charge can propagate through populations of barely-moving charges. Groups of charges can have zero net charge, so do they not exist? And neutral circuitry can support enormous charge flows (current) yet have no net charge at all, so how can there be charge flow if there's no charge?

...a problem with the word "charge": an object with a dipole charge distribution is "charged," and if the charges come together , the object is "neutral," yet no charged particles were destroyed, and

in fact the same quantity of charged particles are still there. So two charges far apart equals "charged," while two close together means "uncharged?" But the particles never lose their charges, so the quantity of charge never varies!

...a problem with the word "charge": when a battery is suddenly connected to a pair of long wires leading to a distant lightbulb, the wires become charged and a wave of net charge propagates along the wires at the speed of light. Yet the individual electrons, the "sea of charge," flow slowly around the circuit. So did the charge go fast or slow? Depends on whether "charge" means the electron sea, or whether it means the imbalance in quantities between the group of electrons and the group of protons in the wire.

...a problem with the word "charge": A capacitor is briefly connected to a battery, so energy is stored in the capacitor. If the leads of the capacitor are now touched together, charge moves from one plate to the other. Does the capacitor now contain less charge? Yes, because its plates are now uncharged. No, because the total quantity of electrons and protons never changed (each electron that left one plate ended up on the other plate.) A "charged" capacitor contains exactly as many electrons as an "uncharged" one. Charge imbalance is called "charge", but electrons and protons are also called "charge."

...mistakenly trying to combine the particle-physics use of "charge" with the everyday-world use. In the everyday world, when positive and negative charges are combined, the result is neutral matter. In particle physics, a combination of positive and negative charge can result in many different things (gamma rays, if positrons and electrons annihilate.) In particle physics, oppositely charged particles can be created from empty space. In the human world, neutral matter must first be present before pos. and neg. charges can be separated out: fur and rubber can "create" opposite charges, but empty space cannot. So, in the everyday world, opposite charge can fall "together," only to be separated at a later time. In particle physics, if you touch a pos to a neg, the particles are *gone*. This is all a question of microscopic energy levels, of chemistry versus nuclear effects. But circuitry and electrical science involves atoms, it does not involve high energy particle annihilation.

...mistaken belief that when a positively-charged wire is connected to a negatively-charged wire only the negative net charge moves as the charges cancel. Actually the positive and negative net charges both move, they flow together and vanish. The net charge is of course an imbalance between pos. and neg. charged particles, and it is true that only the negative particles moved. Net charge is the *difference* between quantities of positive and negative particles, and the net charge can move differently than particles.

...ignorance of the existence of neutral charge. If we add the number of particles in equal quantities of positive and negative charges, we get a larger number: the total number of charges. If we subtract the negatives from the positives, we get zero, the net charge. The sum is linked to the amount of matter and to the amount of electron-sea able to carry current in a metal. The difference is linked to the e-field surrounding the object and to the charge-imbalance on its surface. It's wrong to call the sum and the difference both by the name "charge." For example, an uncharged wire can carry a large charge flow. Does the wire contain zero charge, since it is uncharged? Or does it contain an immense charge, since it contains moving electrons?

...mistaken belief that "electricity" involves only electrons. For example, mistaken belief that "static electricity" is the excess or deficit of electrons. In fact, positive net charge is not a lack of electrons, it is an imbalance, it appears whenever there are more protons than electrons, and fewer electrons than protons.

...mistaken belief that "electricity" involves only electrons. For example, mistaken belief that conductors contain movable electrons. This is true only of metals, and is not true of water, human flesh, sparks, neon signs, batteries, currents in the earth, etc., etc.

...mistaken belief that "electricity" involves only electrons. For example, mistaken belief that "electricity" cannot be easily explained, since electrons are both waves and particles. But the flowing electrified atoms in a non-metal conductor are easily localized, and are even visible! The bizarre Quantum Mechanics which applies to electrons does not apply to "electricity" (meaning charges) in general.

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8. MISC.

Electricity is impossible to understand because of...

...mistaken belief that electricity is a glowing blue "crackly" substance (mistaken belief that sparks or lightning bolts *are* electricity.)

...mistaken belief that electricity is a substance that feels tingly. But high voltage causes body hair to repel and rise. The charge itself has no "feel." And during an electric shock, the creation of ion currents in your hand will be felt by the nerves, but the ion-charges were there to begin with, and only their *motion* causes a tingling sensation.

...mistaken belief that atoms cannot be torn apart. Belief that an atom smasher is required. But all of chemistry, and all of basic electrical physics, is based on torn-apart electron shells. It's only the atoms' nuclei which are never disrupted.

...mistaken belief that electrons in conductors must be forcibly pulled from individual atoms before an electric current can commence. The "jumping electrons" misconception.

...mistaken belief that famous people have the "right answers." Example: if we want a good explanation of electricity, we take the writings of a famous physicist as gospel, as the single best way to explain it. But what if that physicist was a lousy educator? Skill in science doesn't lead directly to skill in explaining what one knows. Fame does not automatically make one into an ideal teacher, so in order to find a good way to teach, look for good ways to teach, don't look for famous people to copy.

...mistaken belief that in order to create teaching techniques at lower levels, we simply take the techniques used at higher levels and simplify them. However, the techniques used to teach college science students are aimed at a population which lives in a very different world than do K-6 teachers and students. Educational material tailored to train scientists is written in a different "language" than the one used at the K-6 level. Advanced material cannot just be simplified, it also

must be "translated." It must use concepts relevant to the world in which its audience lives. It must do this to such a great extent that a K-6 explanation might better be created from scratch, rather than being derived from college physics.

...mistaken belief that, when it comes to explanations, there is one Right Answer. Wrongful pursuit of a single "perfect" way to explain electricity. This goes against the way people grasp concepts. To paraphrase the physicist Richard Feynman, "If you can't explain something in several independent ways, then you don't really understand it." Give up looking for the "correct" explanation, instead try to learn as many different competing explanations as possible. If one of those blind men had known that an elephant was a rope, *and* a leathery wall, *and* a moving hose, *and* a heavy stump, he might have synthesized a sensible view of the whole animal. The situation with electricity is very similar. We can only begin to grasp the nature of that invisible elephant by acquiring many separate and seemingly incompatible viewpoints.

TO BE ADDED:

Protons can never flow? Wrong. Protons are high energy particle beams only? No, instead, in acid solutions all electric currents are actually flows of protons (usually labeled "mobile +H positive hydrogen ions," the chemistry-word for "free mobile proton.") And here's other mistakes:

- Batteries: there's no electric current in the liquid between the battery plates? Textbook diagrams show none. Wrong.
- Batteries: one plate stores up electrons, the other plate collects used electrons after they've powered a device
- Excess positive charge is really just a lack of electrons.
- Capacitors: energy is stored on the surface of the plates.
- Capacitors: charge is actually stored inside the dielectric.
- Radio waves come out of the tip of the radio tower, like bulls-eye ripples.
  (May be part of 1920s fight Marconi-vs-competitors, where competitors' supported ground-waves explanation, where waves issue from the base of the antenna tower.)
- Atoms always contain equal numbers of positives and negatives; one proton always has an electron, atoms can't break up (electrons never removed.)
- Charge conservation is just a rule to memorize? No, because conservation laws mean that the property "charge" is substance-like. We can have matter transport (mass transport,) since mass is a conserved property. We can also have charge transport or "electric current," and it remains independent of the type of charges involved: protons, electrons, ions.
- "Electricity" is the flowing motion of electricity. "Electricity" is created whenever electricity starts flowing.
- Energy flows out through one wire, and the other wire is empty
- Electrons can have a voltage; have energy. No, individual electrons never carry energy along as they flow, instead the energy leaps from electron to electron, where electrons are the wave-medium and the energy is waves. Analogy with air and sound waves.
- Voltage is the "potential do do something?" Voltage is potential energy, the energy per charge? No, voltage is "Potentials," a math term. To clarify, perhaps call it "equipotentials" rather than "potential."

- Voltage is the energy of each electron being moved (so, no electron, no voltage?) No, voltage is the e-fields in empty space. Even when no electrons are being pushed, the "voltage hill" still exists. Voltage is like altitude above the ground, and altitude still exists even without boulders being lifted or potential energy being stored.

Some references for Misconception research

Bill Beaty's internet WWW page:
    http://amasci.com/miscon/miscon.html
Large list of refs on Electricity Misconceptions:
    http://amasci.com/miscon/electref.html
List of books on misconceptions:
    http://amasci.com/miscon/books.html
Proceedings of The 2nd Int'l Seminar - Misconceptions and Educational Strategies in Science and Mathematics
    July 26-29, 1987. Cornell U., Ithaca NY. Vol II and III. On microfilm from ERIC Document Repro. Services. (available on internet, see above link to books)
Mario Iona, "WHY JOHNNY CAN'T LEARN PHYSICS FROM TEXTBOOKS I HAVE KNOWN"
    Millikan Award Lecture, Am J. Phys. 55 (4) Apr 1987 pp299-307
Mario Iona, WOULD YOU BELIEVE...
    Series of columns in The Physics Teacher (AAPT Publication)
Mario Iona, HOW SHOULD WE SAY IT?
    Series of columns in The Science Teacher, 1970-1972

http://amasci.com/miscon/whyhard2.html
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By Rick Littlefield, K1BQT

A Wide-Range RF-Survey Meter

Find and measure the presence of RF energy over a 500-MHz range with this inexpensive, easy-to-build meter.

JOE BOTTIGLIERI, AA1GW

This handy RF-survey meter measures signal levels from –70 dBm to +10 dBm over a 500-MHz frequency range. The detector's wide response and pocket-size portability make it useful for design work and bench-testing, RFI hunting, EMR hazard detection, fox-hunts, surveillance sweeps and many other tasks around the shack and in the field—and it's cheap and easy to build!

Circuit Description

The heart of this project is U1, Analog Device's AD8307 wideband detector IC (see Figure 1). This eight-pin device is a specialized instrumentation chip that accurately reads RF levels over a huge 92-dB signal range, then generates a 0.5 to 2.5-V dc log-output signal to drive a signal-strength indicator. It works a bit like the RSSI (received signal-strength indicator) feature found on many FM receiver ICs, but covers a frequency range spanning VLF to over 500 MHz with a virtually flat response.[1] The IC's logarithmic output is important because it permits us to use a linear-scale voltage display to indicate signal strength in decibels (dB) or decibels referenced to a milliwatt (dBm)—just like a spectrum analyzer.

U1's output feeds an LM3914 LED driver (U2) that controls the meter's 10-segment color-coded LED array. The first LED lights with no signal present to function as a power-on and battery status indicator. The remaining nine LEDs illuminate sequentially, in 10-dB increments, as signal input increases over U1's 90-dB measurement range. U2 is configured in the bargraph mode, which means the LEDs illuminate collectively as the reading increases. This mode draws a bit more operating current than the single-LED mode, but yields a far more colorful and easy-to-read display. To compensate for increased current drain, a momentary press-to-test power switch is used to conserve power anytime measurements aren't being taken. I chose the solid-state LED array over an electromechanical meter because it delivers sufficient accuracy for casual survey work, and because it is virtually bulletproof.

Do you need greater resolution? The AD8307's accuracy is within 1 to 2 dB over its entire dynamic range and could be used to drive a more sophisticated display consisting of a dc-amplified large-scale meter or a recalibrated DVM module. For more complete technical information, data sheets and application notes are available at Analog Device's Web site: **http://www.analog.com/logamps**.

Construction

Nearly all of the parts required to build this project are readily available at your local RadioShack store or can be ordered via RadioShack's Web site **http://www.radioshack.com**. PC boards are available from FAR Circuits,[2] and single quantities of the AD8307s can be purchased from me.[3]

Assembling the meter is simple. The only tricky operation I encountered was mounting the LEDs at the correct height to mate with the panel openings. I solved this problem by making a small spacer-gauge from a scrap of PC board and slipping it under each LED during soldering. Spacing may vary slightly, depending on the LED manufacturer. The LED array is much easier to make if all the diodes are manufactured by the same company and have identical case styles. When mounting capacitors, lay C5 on its side so it clears the front panel. Use caution when installing U1. The AD8307 is static-sensitive, so use a wrist strap, a grounded soldering iron and standard CMOS-IC handling precautions.

Testing and Final Assembly

Perform the initial testing and calibration before mounting the PC board in its case. Attach a fresh 9-V battery to the snap clip. If you don't have a precision signal generator available, apply power and adjust the **ZERO** trim pot (R2) so only the first red LED illuminates. This will provide a rough calibration, and your meter will be

[1]Notes appear on page 44.

A Current Probe for the RF-Survey Meter

This little meter can be a useful accessory for the home experimenter. Microwattmeters can be quite expensive, even if they're used equipment. For example, this meter can be used to indicate the power from an LO in a receiver or transmitter design.

Microwattmeters also have other uses. With a small whip antenna (ie, a "rubber ducky"), the meter can be used as a relative field-strength indicator. With a rubber ducky, W1AW's signal registered at about half scale as I wandered, meter in hand, around ARRL HQ and the grounds. (HQ staff are used to seeing Lab personnel running around doing all sorts of weird things.) Be careful not to place the meter too close to an antenna, though; it is possible pick up too much RF and possibly damage the meter.

Several companies now sell hand-held current probes based on technology similar to that used in this project. Those probes have a current probe composed of a small clamp-on ferrite bead wrapped with a few turns of wire. The meter then can be used to accurately measure small RF currents and as a relative indicator of the amount of RF noise present on computer cables, the outside of a coaxial cable, telephone wiring, etc.

The commercial units I've seen have the ferrite probe mounted directly on the meter. Although this is handy, it can make the meter awkward to use in tight quarters. To measure noisy cables, I want something a bit more portable. I considered using various spring-type clamps available at hardware outlets, but they all seemed far too springy. As I strolled through the tool department at Lowe's, the Vise Grip clamp shown in Figure A caught my eye. The flat parts of the clamp seemed perfectly suited to the task I had in mind. The ferrite beads with plastic covers used here are available from Palomar Engineers, PO Box 462222, Escondido, CA 92046; tel 760-747-3343; **palomar@compuserve.com, http://www.palomar-engineers.com/** and from RadioShack (RS 273-104).

To build the probe, first trim the latch on the ferrite bead's plastic housing so that the sections no longer snap together. Use a few dabs of epoxy to hold each half of the bead to the Vise Grip clamp, as shown in Figure B. (Be careful not to get any glue on the ferrite material.) The clamp's flat sections are perfectly suited for this arrangement; other clamps don't have these flats. Once the glue sets, carefully pry out one ferrite section from the plastic housing. Wrap three to five turns of small enameled wire (#28 will do) on the bead half, leaving about 3/8 inch of wire for leads. Using a small dab of glue to hold it in place, press the bead back into its housing.

Remove about 3/16 inch of insulation from each of the probe's wire ends and solder them to a short length of RG-58 coaxial cable. Cover each lead connection with a length of heat-shrink tubing or insulated sleeving. Install a BNC male connector at the cable's other end. I used a couple of small plastic ties to secure the coax to the clamp; see Figures A and B. (For photographic purposes, I didn't add the heat-shrink tubing.) The probe is now ready to use.

To use the probe, adjust the Vise Grip clamp carefully so that the probe's ferrite sections *just* close when the clamp is squeezed. (Excessive closing pressure may damage the ferrite sections. Once the proper adjustment point is reached, consider locking the adjustment screw in place with epoxy or using a jam nut.) Clamp the probe over the cable you're checking. With four turns of wire on the bead, the cables on several computers at HQ just lit the meter's yellow LEDs. Significantly noisier computers lit the meter's red LEDs, indicating that those cables could be a source of RFI. If desired, you can calibrate the probe/meter combination using a signal generator and a 47-Ω resistor to create a known current.

Microwattmeters can be useful pieces of test equipment for the RF designer. New microwattmeters cost several thousand dollars. This project can get you nearly the same performance at a lot lower cost.—*Ed Hare, W1RFI, ARRL Laboratory Supervisor*

Figure A—A handy probe is made by attaching the two halves of a modified ferrite core to a Vise Grip clamp. Plastic ties secure the cable to the clamp.

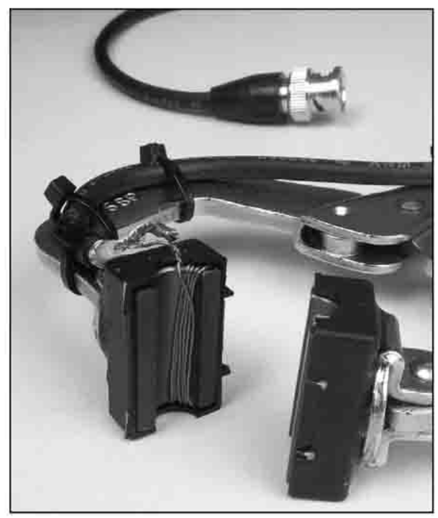

Figure B—Close up view of the modified ferrite core wound with a few turns of enameled wire.

Table 1

Signal levels falling within the survey meter's range span a 90-dB range.

Power (dBm)	*Power (W)*	*Approximate Potential Across 50 Ω*
+10	10 mW	1 V
0	1 mW	300 mV
–10	100 µW	100 mV
–20	10 µW	30 mV
–30	1 µW	10 mV
–40	100 nW	3 mV
–50	10 nW	1 mV
–60	1 nW	300 µV
–70	100 pW	100 µV

reasonably accurate for most survey tasks.

If you have access to a signal generator, install two short leads on the BNC connector and tack-solder them temporarily to the PC-board-input connections. With power applied and nothing connected to the BNC connector, adjust R2 so the first LED illuminates. Then, set the generator for CW output at 100 MHz and connect its patch cable to the BNC jack. Reset R2, as needed, so the last LED just illuminates with +10 dBm of signal applied. When calibrated, reducing the generator's output in 10-dB increments should extinguish one LED per step. If the bargraph reading doesn't change reliably with each step change between +10 and –60 dBm, reset R2 slightly until it does. Note that the low-level green LED (–70 dBm) may remain on continuously because of stray RF pickup on the generator cable.

Once alignment is complete, remove the BNC connector and install the PC board in its case. Secure the PC board in position by the **POWER** switch, omitting the switch's lock washer when installing. Make sure all LEDs are seated in the case openings before fully tightening the switch's mounting nut. Install the BNC connector in its panel and, using short leads, permanently connect it to the PC board.

Operation

Avoid connecting this meter to signal sources more powerful than +20 dBm (100

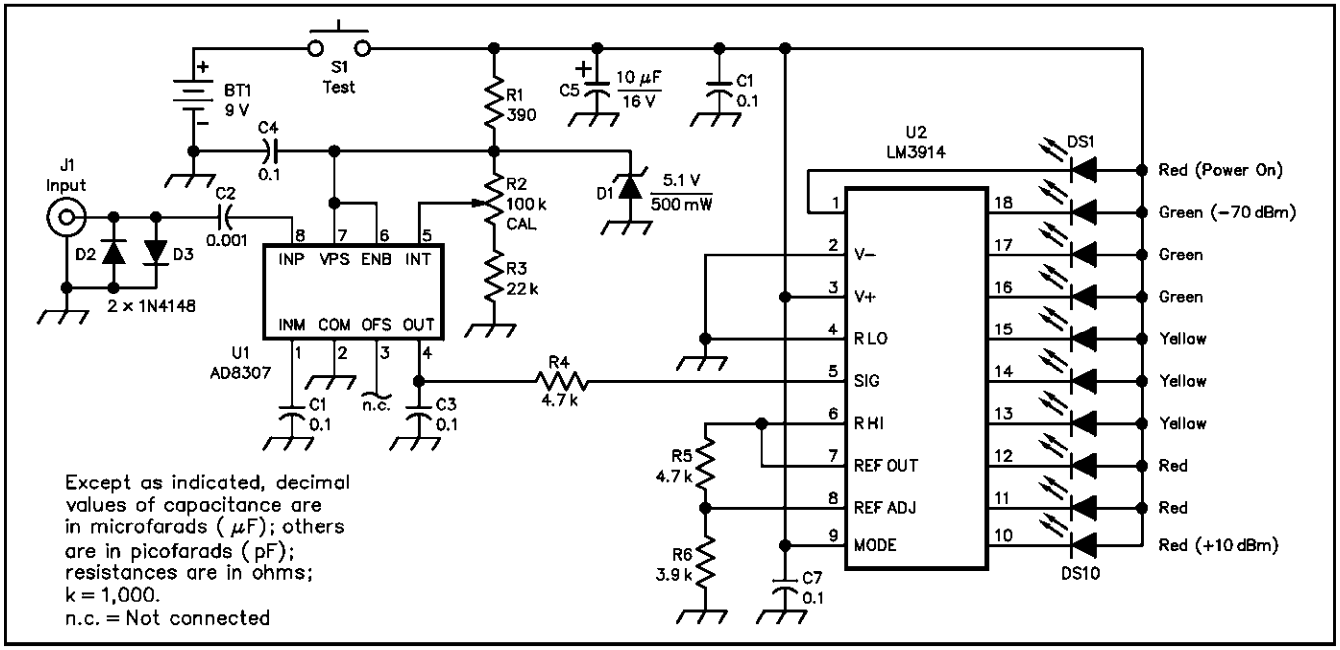

Figure 1—Schematic of the RF-survey meter. Unless otherwise specified, resistors are 1/4-W, 5%-tolerance carbon-composition or film units. Part numbers in parentheses are RadioShack; numbers with 900 prefix are for RadioShack's on-line catalog (http://www.radioshack.com). Equivalent parts can be substituted; n.c. indicates no connection.

C1, C3, C4, C6, C7—0.1 µF disc ceramic
C2 —0.001 µF disc ceramic
C5—10 µF, 16 V electrolytic or tantalum
DS1, DS8-DS10—3 mm LED, red (900-6085)
DS2-DS4—3 mm green LED (900-6086)
DS5-DS7—3 mm yellow LED (900-6087)
D1—1N5231B, 5.1 V, 500 mW Zener diode (900-3088)
D2, D3—1N4148
J1—BNC chassis mount connector (RS 278-105)
R2—100 kΩ, 6-mm horizontal-mount trim pot (RS 271-284)
S1— SPST momentary, normally open switch (RS 275-1571)
U1—Analog Devices AD8307
U2—National LM3914 (900-6840)
Misc: Case—2 3/4×4 5/8×1-inch (HWD) box with 9-V snap clip (RS 270-211)

mW) without first installing an attenuator or sample tap to reduce the input to a safe level. To operate your meter, press the **TEST** switch and observe the bargraph display. If the lowest segment fails to illuminate, check the battery condition before proceeding. The meter draws approximately 20 mA (depending on how many LEDs are lit), so frequent use will necessitate periodic battery replacement.

When making measurements, remember this is a basic survey tool designed for gathering ballpark indications rather than precise data. Also, as with any broadband device, it cannot discriminate between narrowband and wideband energy sources or tell you the frequency of an applied signal. Finally, remember that the dBm is a unit of RF power referenced to a 50-Ω load. The unterminated input impedance of U1 is approximately 1 kΩ at 100 MHz, so readings taken across unknown loads will be *relative* indications that are comparable in dB, but not absolute values in dBm.

Summary

This simple hand-held project uses a low-cost instrumentation IC to detect the presence of RF energy over a 500-MHz range. Approximate signal intensity is displayed on an easy-to-read LED display, and a wide range of sampling attachments may be used for picking up signals. I find I use it often, both on the bench and in the field, whenever I need a quick "reality check" for the presence of RF. It's especially useful for tracking down RFI sources, as Ed (W1RFI) Hare's sidebar, "A Current Probe for the RF-Survey Meter," illustrates.

Notes

[1] Rick Littlefield, K1BQT, "The Analog Devices AD8307 92-dB Logarithmic Amplifier," *Communications Quarterly,* Summer 1999, pp 77-80.

[2] A PC board is available from FAR Circuits, 18N640 Field Ct, Dundee, IL 60118-9269, tel 847-836-9148 (voice and fax). Price: $4 plus $1.50 shipping for up to four boards. Visa and MasterCard accepted with a $3 service charge; **http://www.cl.ais.net/farcir/**.

[3] Contact the author for information.

Rick Littlefield, K1BQT, is an Extra Class licensee and active ham since 1957. An avid builder, RF-product designer and author, he's written for a wide range of Amateur Radio publications since 1969, and was inducted into the QRP-ARCI Hall of Fame in 1996. Rick holds a Master's Degree from the University of New Hampshire and currently works as a technical writer in the electronics industry. You can contact Rick at 109A McDaniel Shore Dr, Barrington, NH 03825; **k1bqt@aol.com**.

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Next New Product

Wi-Fi RF Energy Harvesting for Battery-Free Wearable Radio Platforms

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Abstract— **Wearable devices have huge market potential, but their usage has been limited because means to power such devices is still a challenge. Batteries, the most widespread solution, add size, weight and need periodic recharging which is a huge deterrent. In this work, we propose to eliminate batteries by leveraging Wi-Fi transmissions from nearby devices such as access points and smart phones to deliver power wirelessly to wearable devices.**

We develop a wearable temperature sensor, which harvests energy from Wi-Fi transmissions and transmits data back to an access point. We enable this application by designing an efficient 2.4 GHz Wi-Fi harvesting front-end to power an ANT radio platform with a smartphone as the Wi-Fi source. We study and analyze the effect of OFDM modulation, wide bandwidth (72 MHz) and the bursty nature of 802.11 Wi-Fi signals on the sensitivity, efficiency and the output power of the RF harvester. Our prototype achieves a sensitivity of -16.5 dBm with 100 % duty cycle Wi-Fi transmissions for a target output voltage of 2.05 V and 2.5 μW leakage at the storage capacitor node. This translates to an operating range of about 11.5 cm from a 2 dBm Wi-Fi transmitter on a smartphone and 92 cm from a 20 dBm Wi-Fi access point with a 3 dBi antenna on the wearable device.

I. Introduction

Wearable devices are tiny computation and sensing platforms worn on the body to provide means to periodically track, store and process key physiological parameters, human activity and events [1]. A growing number of health, fitness and wellness applications are using wearable devices such as smart watches, FitBit, Jawbone [2]–[4]. Since wearable devices are mobile and worn on the body, they are required to be small, light, inconspicuous and easy to use and maintain.

On a very high level, wearable devices contain three main components: a computation core, sensor(s) and means for wireless communication. Technology improvements in all these domains have enabled the proliferation of wearable devices by making them smaller, lighter, more functional and power efficient. CMOS scaling, a consequence of Moore's law is enabling smaller, faster and increasingly power efficient digital platforms [5]. Micro-fabrication techniques (MEMS) is leading the way to small and power efficient sensors [6]. Evolving manufacturing, assembly and integration techniques are enabling smaller, lighter and more cost-efficient devices.

However, in spite of all these advancements, limitations in sources of power have hindered the widespread acceptability and usage of wearable devices. Battery technology hasn't scaled and as a consequence, the current approach of using batteries adds cost, size and weight [7]. Batteries have a limited life span and require periodic recharging and replacement, which is a huge deterrent. As the wearable devices scale in numbers and attempt to gain wider acceptability and usage models, there is a need for alternate mechanisms to power these devices. Radio communication is the major power contributor in typical platforms [8] and in this work, we focus on using energy harvesting to power a radio and eliminate batteries on wearable platforms.

Over the years, solar, thermal, motion and RF power harvesting have been investigated for battery-free sensing and computation [7], [9]–[14]. In this work, we will focus on harvesting energy from RF sources since we believe; this approach has several advantages for wearable devices. All devices require an antenna for communication, in principle, the same antenna can be utilized to harvest incoming RF power. On the other hand, solar, thermal and motion based harvesting need additional transducers, which increase size and weight, and is prohibitive for wearable devices. Additionally, wearable devices are extremely mobile and, the output power of solar, thermal and motion based harvesting is inconsistent and unpredictable due to the dependence on external factors such as light, temperature and human movement respectively. On the other hand, on a daily basis, we are consistently surrounded by RF signals such as cellular, TV and Wi-Fi, which are potential means to power tiny wearable devices [15]. In the next section we will explore the applicability of the various RF signals as a source of power for wearable devices.

II. RF Power Harvesting for Wearable Devices

Ambient RF signals such as TV and cellular transmissions from base stations are ideal candidates. However, wearable devices are primarily used in indoor environments such as offices and homes. The typical power level of ambient RF signals indoors is too low for RF energy harvesting and as a result, impractical for powering wearable devices.

Wearable devices are extremely power constrained and to minimize power associated with wireless communication (the major contributor), they operate in close proximity to an access point such as a smartphone. Such devices use short-range energy-efficient wireless protocols such as ANT and BLE to communicate with the access point. On the other hand, access points such as smartphone and tablets have a reasonably sized battery and are recharged periodically. We can leverage this

close proximity to eliminate the battery on the wearable device and instead deliver power from the access point to the wearable device using a dedicated wireless link.

Access points such as smartphones/tablets transmit RF energy in a wide range of frequency bands such as 2G, 3G, LTE, HSPA cellular bands and 2.4 and 5 GHz Wi-Fi. However, cellular transmissions only occur when there is an active phone call or text or data transmission. Additionally, the handset has little control over transmit power since it's dictated by the base station based on the handset's location [16]. As a result, the power transmitted by the phone is unpredictable and location dependent, making cellular harvesting is too inconsistent for powering wearable devices.

Wi-Fi at 2.4 GHz is nowadays ubiquitous in all hand-held devices like tablets and smartphones, which can be leveraged to deliver power. The wearable platform harvests power from 2.4 GHz Wi-Fi transmissions of a nearby access point and uses energy-efficient ANT protocol to transmit the sensor information to the access point.

A. *Smartphone as the power source*

Since smartphone is nowadays ubiquitous and commonly used access point for wearable devices, Wi-Fi transmissions from the smartphone can be used to deliver power. However, the output power of Wi-Fi transmission from a smartphone is low (around 0-2 dBm including antenna and enclosure losses) and this limits the operating distance between the smartphone and the wearable device. In order to maximize the operating range, we optimize the Wi-Fi harvester for sensitivity, i.e. the lowest power at which the harvester can operate. We develop a -16.5 dBm sensitivity harvester that can power an ANT radio and operate up to a distance of 11.5 cm from a 2 dBm Wi-Fi transmitter on a smartphone with a 3 dBi antenna.

B. *Implications of harvesting Wi-Fi signals*

In the United States, Wi-Fi operates in the 2.401 - 2.473 GHz spectrum with 802.11 b/g/n standards, which differ in modulation rates, spectral mask and data rates. The most popular Wi-Fi standard 802.11 g/n uses OFDM (orthogonal frequency division multiplexing) modulation in 20 MHz channels centered around 2412 MHz, 2437 MHz and 2462 MHz. OFDM signals have high peak to average power ratio which increases the rectifier efficiency, when compared to continuous wave transmissions [17], [18]. The impact of OFDM signals on the rectifier performance has not been evaluated in literature.

Unlike RFID and TV transmissions, which are continuous wave transmission, Wi-Fi uses carrier sense multiple access (CSMA) and a packet-based protocol resulting in bursty radio transmission. Therefore, the time averaged output power of Wi-Fi is a function of the network traffic. This phenomenon can be quantified in terms of duty cycle (i.e. fraction of time Wi-Fi signals occupy the channel) and should be taken into account to ascertain the available power on the wearable platform. Hence, the OFDM modulation and packet based protocol makes harvesting Wi-Fi signals a unique challenge compared to prior work on RFID and TV band power harvesting.

Prior work on RF harvesting in the 2.4 GHz frequency band has focused on harvesting power from continuous wave input instead of 802.11 Wi-Fi signals [19], [20]. Additionally, these systems have poor sensitivity and suffer from low efficiency at typical Wi-Fi power levels. Furthermore, these systems are only rectifiers, which output few 100s of mV, insufficient to power sensing and computational platforms. Recent work has considered the bursty nature of Wi-Fi on the performance of rectifier [21]. But, it is also just a rectifier and lacks the boost converter and power management required to power a radio platform. In [22] authors design a rectenna patch and power management solution for Wi-Fi harvesting, but the harvester suffers for poor sensitivity and efficiency. The authors characterized the rectenna (excluding the boost converter and power management) for continuous wave input and did not study the impact of Wi-Fi signals on energy harvesting. Additionally, they used an antenna array, which increases the size of the platform and is prohibitive for wearable applications.

The power associated with radio communication is typically high and requires a big storage element and optimized power management for efficient operation. This challenge has not been addressed in literature for Wi-Fi energy harvesting. In this work, we develop a 2.45 GHz Wi-Fi harvester to power an ANT radio platform. Our system described in Section III, achieves a sensitivity of -16.5 dBm with 100 % duty cycle Wi-Fi transmissions for a target output voltage of 2.05 V and 2.52 μW platform leakage at the output. We study and analyze the implication of Wi-Fi bandwidth (72 MHz), OFDM modulation and the bursty nature of Wi-Fi transmissions on the efficiency, sensitivity and the power available at the output of the harvester in Section IV.

III. Design and Architecture of the Wearable Platform

In this section, we discuss the design and implementation of a battery-free wearable platform, which uses harvested power from Wi-Fi to sense temperature and transmit the sensor data back to an access point using ANT radio protocol. All components of the wearable platform including power management, computational core, temperature sensor and the radio, are powered from harvested Wi-Fi signals.

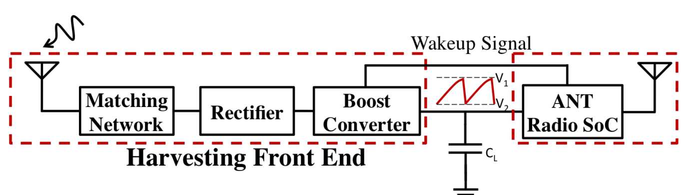

Fig. 1. The overall architecture of the Wi-Fi powered ANT radio wearable platform

Fig. 1 shows the architecture of the Wi-Fi powered wearable radio platform. The system consists of two main blocks: the harvesting front end (antenna, matching network, rectifier and a boost converter) and the ANT radio SoC. The RF signal is captured by the antenna and converted into DC power in a

two-step process: a single stage rectifier first converts the RF to low voltage DC and is then boosted to a higher voltage and stored on a capacitor [14]. The ANT SoC comprises of the computation core, temperature sensor and the radio and is powered by the boost converter. Note that in this prototype we use separate antennas for harvesting and communication. However, in principle since both Wi-Fi and ANT operate in the 2.4 GHz ISM band, a single antenna can be multiplexed (with additional 0.5 dB loss using a switch similar to [23]) between the harvesting and communication front end.

A. Design philosophy and metrics

The power available from Wi-Fi is typically very low (few μW), hence it is imperative that the platform is designed to maximize the harvested power and minimize the overall power consumption. To accomplish these two goals, the wearable platform operates on the principle of duty cycling. By default, it stays in a low power mode consuming minimal power (for state retention), efficiently harvesting power and accumulating charge on a capacitor. As soon as the capacitor has sufficient energy, the platform switches to an active mode, samples sensor data, encapsulates the sensor information in a packet, transmits the packet to the access point using ANT protocol and then transitions back to the sleep mode.

An RF powered platform has two main design metrics: the maximum operating range from the access point and the update rate of the sensor information, both of which are a function of harvesting efficiency and power consumption in the two modes of operation. Since the power available from Wi-Fi is very low, the platform spends majority of the time in the low power mode harvesting energy and occasionally goes to the high power mode. The power consumption in the low power mode, also known as the leakage of the platform, affects the harvesting efficiency and determines the maximum operating range from the power source. To maximize the operating range, the leakage of the platform should be minimized. Additionally, the average power consumption and the time spent in the high power mode (including radio transmission), determines the energy required for every active operation. This energy determines the update rate of the data transmissions, and should be minimized for high update rates.

B. Antenna

Wearable devices have stringent form factor constraints which limit the size and hence the gain and efficiency of the antenna. Furthermore, wearable devices are mobile and experience a great deal of variation in orientation and distance with respect to the access point. Hence, a directional antenna is not recommended. An inverted F antenna [24], a good trade-off between size, antenna gain and efficiency was chosen. The antenna measures 25.7 mm x 7.5 mm and has an efficiency and peak gain of 80% and 3.3 dBi respectively.

C. Matching Network and Rectifier

An RF rectifier is characterized by its efficiency and sensitivity. Efficiency at an input power is the ratio of the output DC power to the input RF power. Sensitivity is defined as the minimum input power at which, the rectifier can charge the storage capacitor to the target voltage. The efficiency and the sensitivity determine respectively, the update rate and the operating range of the wearable device. In this work, optimize the sensitivity of the rectifier to maximize the operating range.

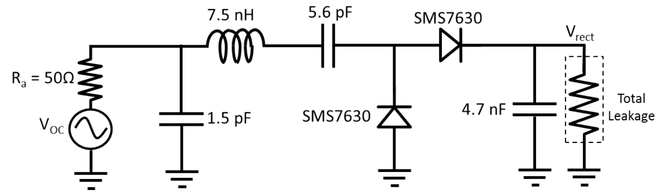

Fig. 2. The RF front end design of the rectifier to convert the Wi-Fi signal at 2.45 GHz into an output DC voltage.

Fig. 2 shows the one stage Dickson charge pump rectifier and the matching network used in this work. High RF to DC conversion efficiency is achieved by using low threshold voltage and junction capacitance SMS7630-061 schottky diodes [25] in the rectifier. Additionally, the miniature 0201 SMT packaged diodes minimize the losses associated with package parasitics. To minimize the power loss due to reflections at the antenna port, the rectifier front end is matched to the 50 Ω antenna using an LC match with high Q RF inductor and capacitor. The tuning of the front end was performed using a Vector Network Analyzer (VNA) and was optimized to achieve the lowest input power sensitivity. In the prototype implementation, we used a 7.5 nH series tuning inductor with a 1.5 pF parallel tuning capacitor.

The input impedance of the rectifier at -16 dBm continuous wave input across the frequency range of 2.401-2.473 GHz was measured using a VNA and is shown in Fig. 3 on a Smith chart. Fig. 4 plots the power reflected at the antenna interface as return loss and it can be seen that the matching is not optimal across the entire Wi-Fi bandwidth. This can be attributed to the fact that a single stage matching network with high Q is used for matching a large bandwidth signal (72 MHz wide) [26]. This variation in the input impedance results in variation in efficiency of the rectifier across the Wi-Fi channels and will be discussed in the section IV.

The efficiency and sensitivity of the rectifier at a given operating frequency are a function of the leakage power of the platform and the desired output voltage. In order to achieve high efficiency and sensitivity, the leakage of the platform was minimized. In this work, for a target output voltage of 2.05 V and 2.5 μW leakage at the output, we achieve a sensitivity of -16 dBm for a continuous wave input. This leakage includes the contributions of the DC-DC converter and the ANT radio SoC.

The matching network was designed and the sensitivity of the rectifier for a continuous wave input signal was evaluated using a VNA. However, 802.11n Wi-Fi transmissions use OFDM modulation, which have high peak to average power ratio. Since the rectification process is non-linear and diodes

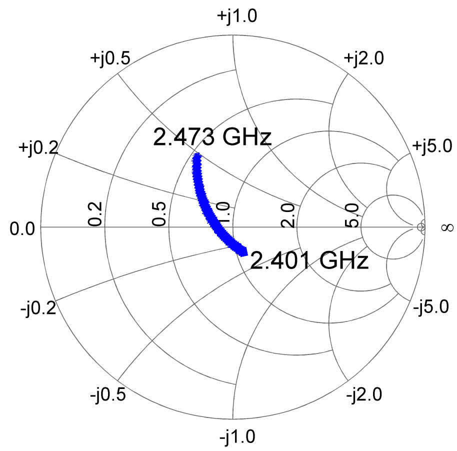

Fig. 3. Measured input impedance of the RF energy harvester for a -16 dBm continuous wave input across the Wi-Fi band.

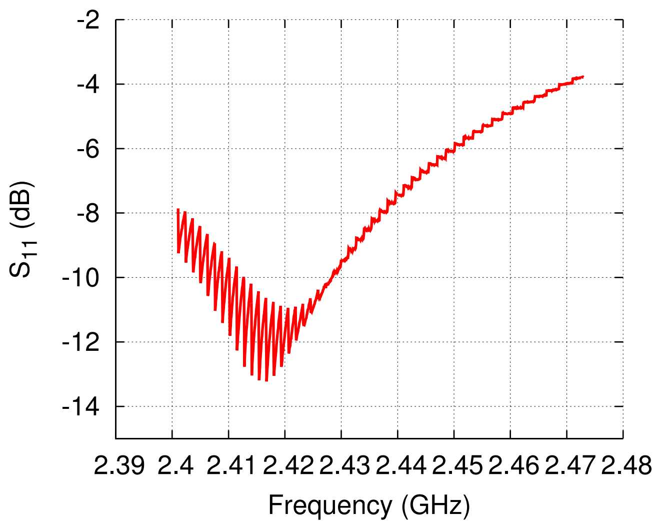

Fig. 4. Measured return loss at the input of the rectifier for -16 dBm continuous wave input across the Wi-Fi band. The ripple on the S_{11} is due to the switching in the boost converter which gets reflected on the input port of the RF harvester.

have a fixed voltage threshold, the performance of rectifier under excitation of signals with high peak to average power ratio will differ from continuous wave input [18]. We evaluate the impact of Wi-Fi transmissions on energy harvesting in Section IV.

D. DC-DC Converter

The low output voltage of the one stage rectifier stage is converted to the required voltage rail by the bq25570 energy harvesting solution [27]. bq25570 contains a high-efficiency boost converter, which can cold start from voltages as low as 330 mV and can operate from a 100 mV input once started. The boost converter also incorporates a voltage based maximum power point tracking (MPPT) mode (after cold start) [27]. Every 16 seconds, the boost is disconnected for 256 ms and the open circuit voltage is sampled and used as a reference for MPPT. For example, the MPPT can be set to 80% or 50%, which regulates the input of the boost to 80% or 50% of the open circuit voltage respectively. However, this is impractical for Wi-Fi harvesting because Wi-Fi packets are non-continuous. If the open circuit sampling coincides with a period when there are no Wi-Fi packets, the sampled open circuit voltage is zero. This results in boost converter pulling the input to zero resulting in system failure. To mitigate this issue, a resistive divider between the output of the boost converter and ground was used to generate a reference voltage for the MPPT boost converter. For the one stage rectifier followed by the boost converter, 300 mV was found to be optimal MPPT reference voltage.

The bq25570 chip also contains a programmable voltage supervisor, which was used for duty cycle operation of the ANT SoC. The chip periodically measures (every 64 ms) the voltage on the storage capacitor and provides a wake-up signal when the voltage on the storage capacitor reaches the programmed threshold. In this work, we set the trigger threshold at 2.05 V. Please note that the wake-up signal is 64ms long, which has implications on the design of the ANT radio SoC.

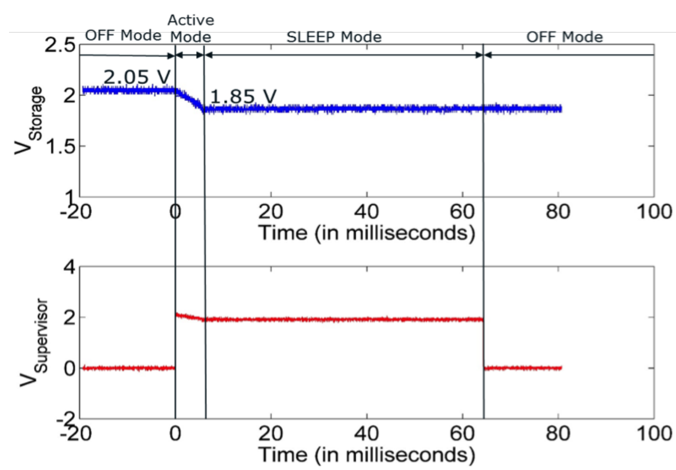

Fig. 5. The wakeup signal from the voltage supervisor of the bq25570 chip and corresponding voltage on the storage capacitor as a function of time. The various operating modes of the ANT SoC are annotated.

E. ANT Radio SoC

We used the nRF51422 ANT SoC, which contains an ARM core, a range of analog and digital peripherals, integrated temperature sensor, the ANT protocol stack and the radio front end [28]. The ANT protocol stack is incorporated as pre-complied, pre-linked binary files called SoftDevice, which can be programmed into the SoC.

The ANT SoC transitions from the low power mode to the high power mode based on the wake-up signal from the supervisor in the bq25570 chip. This signal is typically 64 ms long and the ARM core in the SoC has unique interrupt characteristics, which necessitates the following configuration to minimize the leakage and active power consumption.

- By default the SoC operates in the OFF mode wherein it consumes only 350 nA of leakage current. It is configured to transition into active mode on a level-triggered input.
- When the voltage on the wake-up pin transitions to high, the SoC goes into ACTIVE mode. Since the SoC is transitioning from OFF mode, the CPU is reset. Upon wake-up, the CPU registers and the SoftDevice for the ANT protocol are initialized. A temperature sensor measurement is taken, encapsulated in a packet and transmitted using asynchronous ANT transmission to the access point. As soon as the transmission is complete, the SoC transitions to SLEEP mode. The SoC is configured to transition from SLEEP to OFF mode on the falling edge of the wake-up input from the voltage supervisor.
- In SLEEP mode, the SoC consumes 3.8 μA and stays in SLEEP mode as long as the wake-up signal is high (typically around 64 ms, which is the latency of the voltage supervisor). Once the falling edge on the wake-up pin is detected, the SoC transitions to OFF mode.

The wake-up signal and voltage of the storage capacitor corresponding to the different operating modes is shown in Fig. 5. We wrote an optimized firmware to minimize the energy consumption of one active mode operation (wake-up, temperature measurement, wireless transmission and going back to sleep) to 64 μJ. Based on this energy requirement and 1.8 V voltage minimum for the SoC, we chose a 160 μF storage capacitor and a wake-up threshold of 2.05 V. This resulted in a minimum voltage of 1.85 V (50 mV overhead) on the storage capacitor.

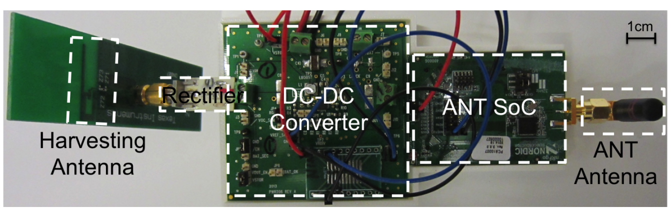

Fig. 6. The prototype implementation of the Wi-Fi powered wearable platform using off-the-shelf shelf components

We implemented the Wi-Fi powered wearable platform using commercial off-the-shelf components. The rectifier and matching network was custom designed on a low loss Rogers 4350 substrate and was interfaced with bq25570 and ANT SoC development boards. The developed prototype is shown in Fig. 6. The wearable platform cannot cold start from harvested Wi-Fi signals. This limitation is solely due to the start-up behavior of the ANT SoC. When the voltage at the input to the SoC rises slowly (slow charging of storage capacitor form harvested Wi-Fi power), the chip goes into an indeterminate state consuming large amount of current. This drains the energy from the storage capacitor and severely limits the harvester efficiency. As a compromise, we initiate a jump-start by connecting an external 1.8V voltage source to the storage capacitor. As soon as the storage capacitor is charged to 1.8V, the chip gets initialized, the 1.8V source is disconnected and the platform runs continuously and sustains itself on harvested Wi-Fi power. Alternatively, a switchable element can be introduced between the storage capacitor and the ANT SoC to mitigate the ANT SoC startup issue. For example, an LDO (such as [29]) with enable functionality controlled by the supervisor output can be used to ensure that the ANT SoC connects to the storage capacitor only when the voltage is above 1.8 V.

IV. Experimental Results

As explained in the previous section, the sensitivity and the efficiency of an RF energy harvesting front end is a function of input power, leakage of the platform and the desired output voltage. Hence, it is imperative that we evaluate the harvester taking into account all these factors. Additionally, unlike prior work, which focused only on the rectifier, here we evaluate the efficiency of the entire RF harvesting chain, i.e. rectifier and the DC-DC converter. The target output voltage is 2.05 V (required by the ANT SoC) on a $160\mu F$ capacitor and the total leakage power of the entire wearable platform (2.5 μW) will be taken into account. To measure the efficiency and output power of the harvesting chain, we simply measure the time between successive active mode operations of the wearable platform. Since, each active mode operation requires 64 μJ, the time between successive operations is used to ascertain the average output DC power available for active mode operation.

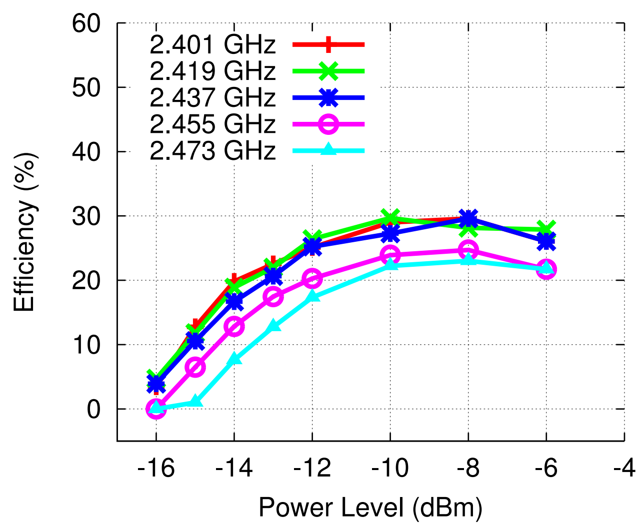

Fig. 7. The overall efficiency of RF harvester as a function of the operating frequency and input power for a continuous wave input.

A. RF harvesting with continuous wave input

First, we connect the rectifier front end to an RF signal generator and vary the input power and frequency of operation for a continuous wave signal. Fig. 7 shows the efficiency of the harvester as a function of the input power and operating frequency. It can be seen that the harvesting front end achieves a sensitivity of -16 dBm for a continuous wave input.

Additionally, as input power is increased, the harvesting efficiency first increases, reaches a maximum and then decreases. This phenomenon can be understood by noting that

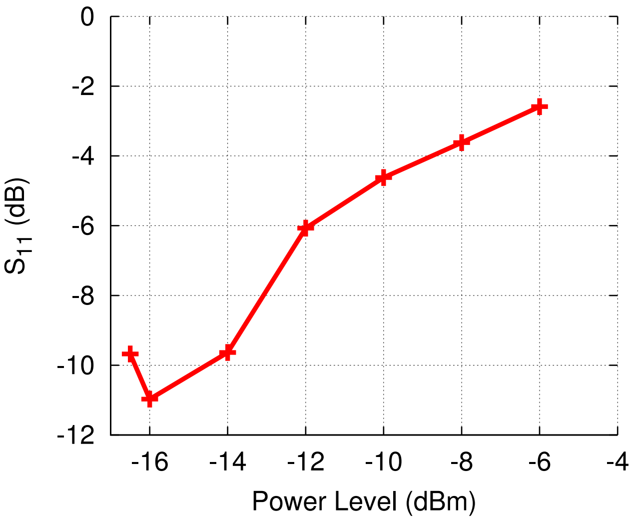

Fig. 8. The return loss at the antenna terminal of the RF front end as a function of the input power at 2.412 GHz continuous wave input.

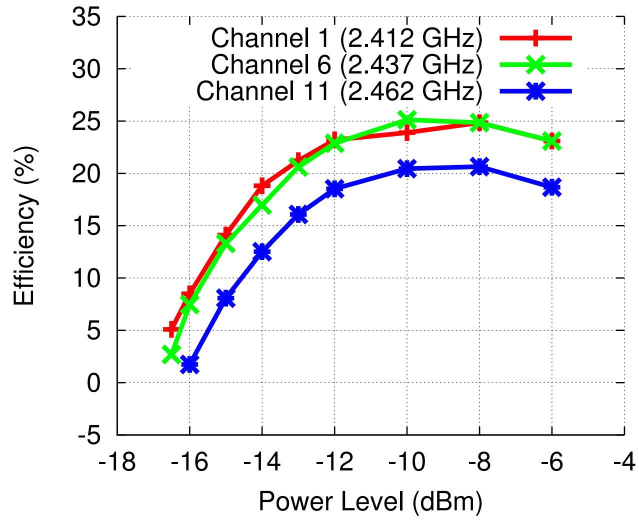

Fig. 9. Efficiency of the RF harvester for an input Wi-Fi signal and variation as a function of the Wi-Fi channels

the RF to DC efficiency depends on impedance matching (i.e. minimizing return loss at the antenna terminal) and RF to DC conversion of the rectifier charge pump. At low input power, the rectifier charge pump efficiency is low since the voltage levels are close to the threshold voltage of the diodes. As input power is increased, the voltage levels at the input of the rectifier charge pump increase leading to better rectification in the diodes of the charge pump. However, as seen in Fig. 8, as power increases, the impedance mismatch and hence losses due to reflection at the antenna terminal increase. This is a consequence of static impedance matching, optimized at a single input power of -16 dBm, which is the sensitivity of the rectifier. These two phenomena trade-off leading to lower efficiency at low input power (low efficiency of rectifier charge pump dominates), increased efficiency as input power is increased (higher efficiency of rectifier charge pump as voltage levels increase), with the maximum at -8 dBm and reduction in efficiency as losses due to impedance mismatch dominate.

Fig. 7 also shows that the efficiency of the harvester varies with operating frequency. The harvester has a better performance at 2.401, 2.419 and 2.437 GHz when compared to 2.455 and 2.473 GHz. This variation can be explained by noting that the front end is better matched at lower frequency than at higher frequencies as shown in Fig. 4.

B. RF harvesting with Wi-Fi as input

Next, we evaluate the performance of the harvester with Wi-Fi signals as input. A vector signal generator configured to transmit 4091 bytes long Wi-Fi packets with 64 QAM subcarrier modulation and no idle time (i.e. 100% duty cycle) was connected to the rectifier front end. The operating frequency and average power of the transmitted Wi-Fi packet were varied. Fig. 9 shows the efficiency as a function of input power for the three Wi-Fi channels (Channels 1, 6 and 11). When compared to the efficiency for continuous wave input (Fig. 7), the efficiency under OFDM signals is lower at high input power, but higher at low input power, which can be explained as follows. At high input power, the voltage at the diode for continuous wave input has already crossed the threshold of the didoes in the charge pump. The high peak to average power ratio of 64 QAM OFDM modulation results in peaks and valleys. But since diode conduction is exponential, the losses due to valleys do not compensate for the gains due to the peaks, which results in lower efficiency at high input power when compared to continuous wave input. But as the input power is reduced, the voltage levels are closer to the threshold of the diode and the gains due to the peaks supersede the losses due to valleys, leading to higher efficiency at lower input power. As a result, the sensitivity of the rectifier increases to -16.5 dBm for OFDM modulated Wi-Fi transmissions.

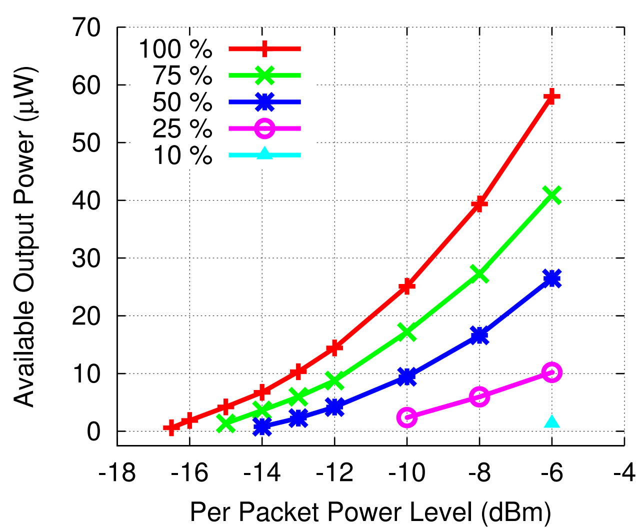

Fig. 10. Output power of the RF harvester as a function of the duty cycle and input power for Wi-Fi transmissions in Channel 6 of the 2.4 GHz Wi-Fi.

C. RF energy harvesting as a function of Wi-Fi duty cycle

Finally, we use the same vector signal generator setup and vary the duty cycle of Wi-Fi transmissions on Channel 6 (2.437 GHz). Fig. 10 shows the available DC power at the output of the RF harvesting chain as a function of the duty cycle of Wi-Fi transmissions. The x-axis plots the per packet power of the Wi-Fi transmissions. It can be seen that as the duty cycle of Wi-Fi transmission is reduced, the power at the output of the rectifier is also reduced, which leads to lower sensitivity, shorter operating range and slower update rates. This can be intuitively understood by noting that the leakage power of the platform is constant (2.5 μW) whereas as the duty cycle scales down the average input power linearly reduces, resulting in lower power available at the output.

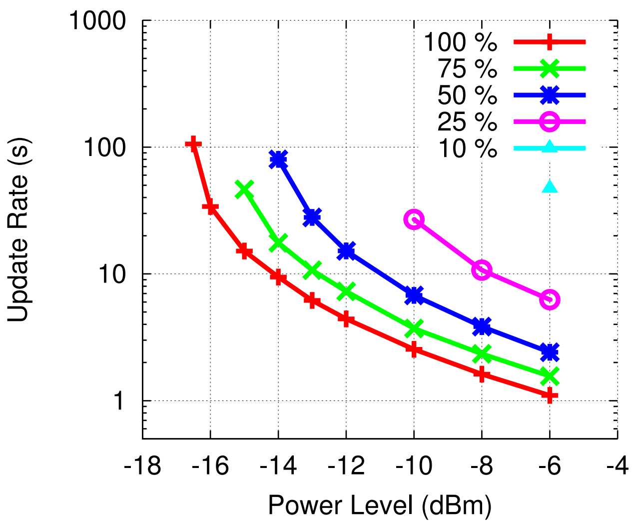

Fig. 11. Update rate of sensor data transmissions using ANT radio protocol as a function of Wi-Fi characteristics.

D. Sensor update rate as a function of Wi-Fi characteristics

Fig. 11 shows the update rate of the temperature sensor as a function of input power and duty cycle. It can be seen that when the input power and duty cycle is high, the update rate from the wearable platform is in the order of few seconds but as the average available power decreases, a consequence of either lower input power and/or lower duty cycle, the update rate of the temperate also decreases to one reading per 100 seconds. For typical sensor applications, a data point every couple of minutes is sufficient and hence, Wi-Fi harvesting is a suitable solution.

E. Operation of wearable platform with a Smartphone

Finally, we evaluate the full wearable platform performance including the antenna with a smartphone as the power source. Since the performance of the harvester is a function of input power and duty cycle of Wi-Fi transmissions, it is imperative that the Wi-Fi power source, the smartphone, is configured to transmit at high duty cycle and high transmit power. However, as noted before, smartphones have reduced transmit power. We conducted experiments in anechoic chamber and laboratory setting to ascertain the per packet average transmit power of Wi-Fi transmissions. We placed a Wi-Fi antenna connected to a high frequency oscilloscope and measured the power received from the smartphone at different distances. We de-embedded the antenna gains and used Friis equation to experimentally ascertain that the per packet average transmit power of typical smartphones (including antenna and enclosure losses) is around 2 dBm.

Next we maximize the duty cycle by configuring the smartphone as a Wi-Fi hotspot. We connect another device to the hotspot and stream a Youtube video from the hotspot which results in high duty cycle Wi-Fi transmissions (about 75%) from the smartphone. In our experiments, we achieved a maximum operating distance of 11.5 cm between the smartphone acting as a Wi-Fi hotspot and the developed Wi-Fi powered wearable platform. Note that instead of using the smartphone as a hotspot, an application on a smartphone can also ensure high duty cycle Wi-Fi transmissions.

V. Discussion and Future Work

We have designed and evaluated the ***first Wi-Fi powered battery-free wearable radio platform***, which operates in close proximity of a smartphone. Although the current implementation can operate only up to a distance of 11.5 cm from a typical smartphone (with 2 dBm Wi-Fi transmit power), a Wi-Fi powered radio has the potential to be a battery-free solution for a range of use cases. For example, the current prototype implementation could be used to power and communicate with a battery-free EMG sensor strapped to the knee from a smartphone kept in the pocket of the user. However, to enable a truly ubiquitous battery-free wearable radio platform, the platform should operate at longer ranges without significantly impacting the usability and battery-life of the smartphone.

A. Improving the operating range

The operating range can be increased by improving the sensitivity of the RF harvester and/or increasing the output power of the source i.e. the smartphone. The sensitivity of the RF harvester can be increased by using an integrated on chip rectifier, lower threshold diodes in rectifier, lower V_{in} threshold DC-DC converter and by reducing the leakage power of the platform. Additionally, the Wi-Fi chipsets used in typical smartphones are rated to output up to 20 dBm. Software modifications to the phone can increase the Wi-Fi transmit power to 20 dBm and the operating range of the current prototype can be extended to 92 cm.

B. Usability and impact on the battery life of smartphone

In addition to increasing the operating range, power delivery should not degrade the usability and battery life of the smartphone. Although, the power consumption of smartphones is a complex function of power profile of chipsets, operating system, application software and user behavior, we will investigate the performance under some basic set of assumptions. Typical smartphones have a 3.8 V, 2200-4000 mAh battery,

which can last up to 12 hours on a single charge. Wi-Fi chipsets on smartphones have an energy efficiency of 1.3 $\mu J/bit$, which translates to an average power consumption of about 100 mW for 2 dBm Wi-Fi transmission [30]. Hence, delivering power using Wi-Fi reduces the battery life of the smartphone by about 8-15 %. However, we note that the above analysis only includes the power consumption of the Wi-Fi chipset and not the account the power overhead associated with CPU, memory, etc. Additionally, since the sensor update rate varies with duty cycle (Fig. 11), the duty cycle of Wi-Fi transmissions from the smartphone can be adapted with distance and application needs to conserve the battery life of the smartphone. The focus of this work is the design of the Wi-Fi harvesting platform. Design and evaluation of smartphone performance acting as a Wi-Fi power source is a topic of future work.

Finally, we also note that the communication protocol can be optimized to meet the specific needs of the application and the power requirements of the radio. For example, instead of transmitting every sensor reading, the platform can periodically sense, store data in memory and transmit the aggregated back to the access point in burst. The design and optimization of the communication protocol is also a topic of future research.

VI. Conclusion

In this work, we have developed the first Wi-Fi powered radio platform. We presented the design and analysis of the Wi-Fi harvesting chain and studied the impact of wide band nature of Wi-Fi transmissions, OFDM modulation and duty cycle on the performance of the harvester. Our prototype achieves a sensitivity of -16.5 dBm with 100 % duty cycle Wi-Fi transmissions for a target output voltage of 2.05 V and 2.5 μW platform leakage at the output. The developed Wi-Fi powered radio platform can operate up to a distance of 11.5 cm from a 2 dBm Wi-Fi transmitter (on a typical smartphone).

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The Bitx40 Project as built by N6QW

Resource Page

Somewhere in the time period 2003/2004 an ingenious ham from India, Ashar Farhan VU2ESE, came up with a revolutionary concept. The idea was a simple design for a low cost easy to build SSB transceiver! His transceiver design was aimed at many of the hams in his native India that wanted to share the joy of talking across the ionosphere; but unfortunately were on a limited budget. To make the project cost efficient, a bilateral design concept was employed were many of the same circuits were used both on transmit and receive. The part count was very low and for the most part employed the common 2N3904 transistor (about one dozen). Sensing the lack of parts such as ferrite core transformers his suggested alternative for coil forms were nylon washers.* For an output device the IRF510 was pressed into service which yielded about 5 watts on 20 Meters. The project was a huge success and forward to today, thousands have been built world wide. I almost failed to mention that most of his design was done while on a long airplane flight from India to the UK. Common folklore has it that he used the calculator in his smart phone and most of the design was on the backs of cocktail napkins. VU2ESE's original Bitx20 project can be found here.

Shortly after going public with his project I built one in the Spring of 2004. You can see my rig in the photo below. My call at that time was W6JFR.

[* The design I used (his original) specified the nylon washers which I converted to ferrite core transformers and here is the conversion .]

The radio worked pretty well and my contribution was to add a VFO stabilizer and LCD display. Pretty "uptown" for 2004! There is a Bitx20 users group on Yahoo Groups and if you are reading this

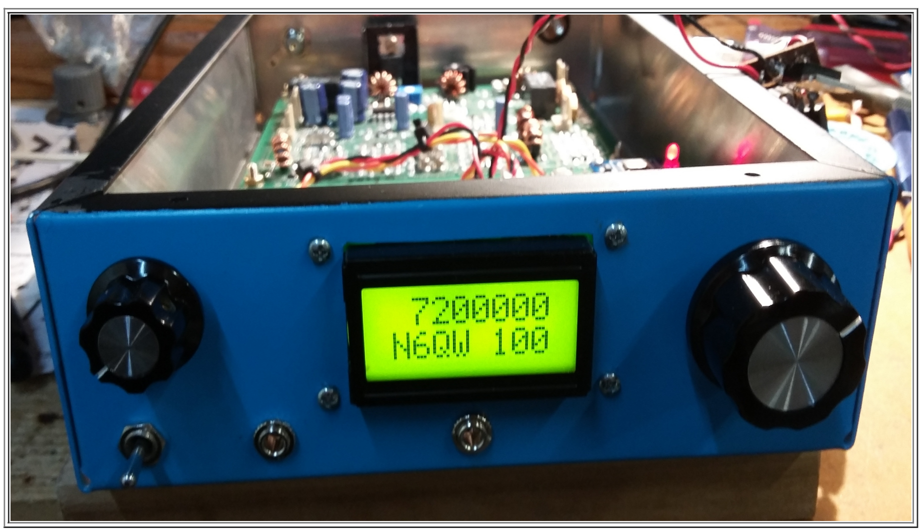
and are not already a member this is a must join group .

Fast forward to today and now Farhan has taken the project one step further and is offering a complete built Bitx40 with all the hardware for the amazing sum of $45 shipped from India. [That was the offering in Novemeber of 2016.] You can find the detail of this offering here . The rig is fully built and tested and the only effort on the part of the buyer is to fit the radio to a suitable enclosure, install the controls and wire the controls to the single board rig. The board is fitted with header pins and wire bundles included with the kit have the mating connector that plug into the board. The builder is left with the task of soldering the other ends of the cable bundles to the controls and installing it in an enclosure of their choice.

The most recent offering of the kit (January 2017) now includes the Digital VFO Option complete with an LCD display and Si5351 Phase Locked Loop Clock Generator. The price for the Bitx40 board and "Digi" VFO is $59. [Note: I can't buy the parts for $14 --so a bargain indeed!]

The Bitx40 is fully operational out of the box and even includes the microphone element. Frequency control is by means of a varactor tuned VFO. But the intent of the board is for experimentation and one area that is available to the user is to replace the varactor VFO with a DDS (Direct Digital Synthesizer) or PLL (Phase Locked Loop Clock Generator) so that there is no drift and the readout is highly accurate. It is strongly recommended that the rig be initially built "as supplied". It is whole order of magnitude of difficulty to jump right into a DDS or PLL, even for an experienced builder. Thus get it working first as supplied by Farhan, then you have a benchmark of performance.

I have just started working on my Bitx40 and am at the point of connecting the wires to the controls. I will be using an Ardunio Pro-Mini to drive an AD9850 DDS to supply the LO (Local Oscillator) signals. We are probably several days before we are ready for an on the air test hopefully before Christmas 2016.



How to start the build of the Bitx40?

All of us suffer from impatience! The arrival of the Bitx40 typically takes about three weeks via India Post. The rigs get shipped very quickly but it still takes three weeks to get it in your hot hands. The first thing you DON'T want to do is haywire it together in about 10 minutes only to find out you have blown up your new rig.

I will present to you an ordered method for completing your rig and getting it on the air while trying to avoid the problems that haste often brings. With apologies to builders who have been around the

horn my approach assumes that the builder is just starting out building a first time project. You are never too old to learn something. I have developed my approach into phases and as this website develops there will also be you tube videos with links that will support the phases.

he Arduino/AD9850

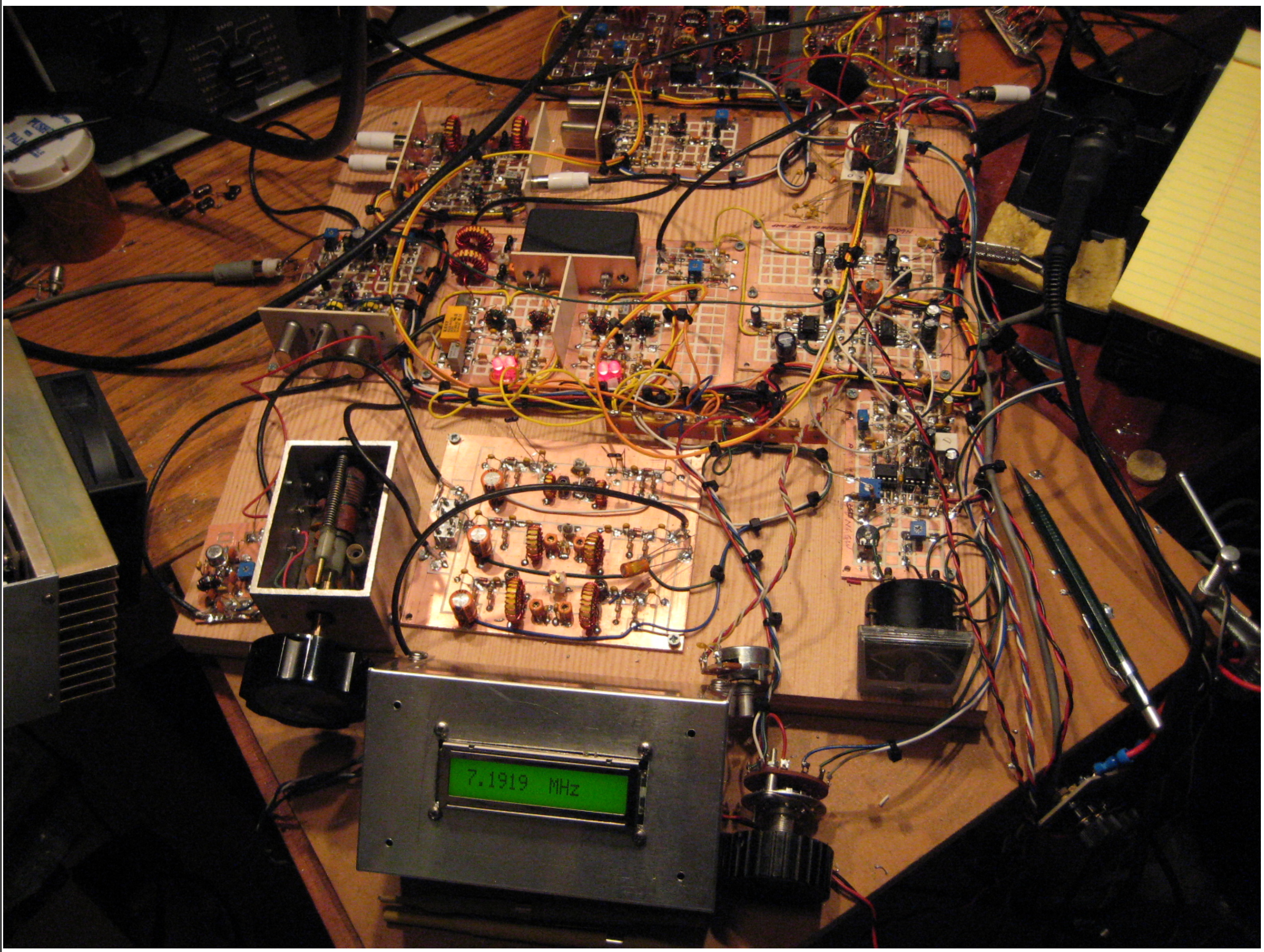
Phase 1: Getting Organized ~ The Noodling Effect!
Phase 2: Initial Layout of the Rig ~ Thinking in the Box
Phase 3: Mechanical operations ~ Punching/Drilling/Filing
Phase 4: Fit Check and initial wiring
Phase 5: Initial testing without power applied
Phase 6: Power on Testing
Phase 7: Adding the Arduino / AD9850 & OLED + Si5351
Phase 8: Hacking the Bitx40

Post Script: My Bitx40 has been on the air and in just one day made four contacts with stations in Arizona and Nevada. Typically the distance was in the 200 to 300 mile range. The signal reports were telling in that the signal quality and "punchy audio" were considered to be quite good --but you know the OF's (Old Farts) on 40 Meters, they complain if your signal is not 40/S9. There is even a video of the first contact which can be seen here.

Phase 2 ~ Thinking Inside the Box

While it may be exciting to have your rig operate "al fresco", with it sprawled out all over the work bench ultimately one day you will want to move it and that is when having everything all neat and tidy comes into play.

In 2009 I built a Tri-Band SSB transceiver made mostly from components that traced their roots back to a Heathkit HW-101. Essentially I made a QRP solid state version of the HW-101. Here is what it looked like sprawled out all over the workbench.



It was only after I had it to this stage and working that I thought about how to get this into a box. It was a real challenge and the final box was a half cubic foot. 12x12X6! My point I should have thought about the box before I built the radio and the final product looked like this:

The same applies to the Bitx40. Earlier I suggested the use of two enclosures one of which is a very nice metal box that is about 7X5X4 and the other is a chassis that is 6X10X2. Both will work but the box will take a bit more noodling to get all to fit inside. There is also another factor here. The Bitx40 as supplied will put out about 5 watts. One of the "hacks" is to feed the final RF output device from 24 volts while the rest of the radio is fed with a nominal 12 Volts. This ups the Pout to about 20 watts but will require a substantially larger heat sink!

The Bitx40 rig comes with an un insulated heat sink that will handle the 5 watts so you are good there. But suppose you want the higher power then what is the solution? The answer is to use the case itself with an added appropriate insulator kit. Thus how you initially install the board in the case will/may impact the higher power version. With all of the metal surface of the case it should do a pretty good job at handling the heat sinking requirements. BUT you have to think about that before you start drilling holes or cutting metal.

Another factor is shielding. At 5 watts and using the AD9850 DDS (Direct Digital Synthesizer) or the Si5351 PLL (Phase Locked Loop Clock Generator) may not be an issue. But with 20 watts running around inside the box may require internal shielding. Thus you must think about how to do that up front.

In my build I used the chassis as it was available and I have several external RF linear amplifiers so my decision process bypassed any thought of a 20 watt version and I just moved on.

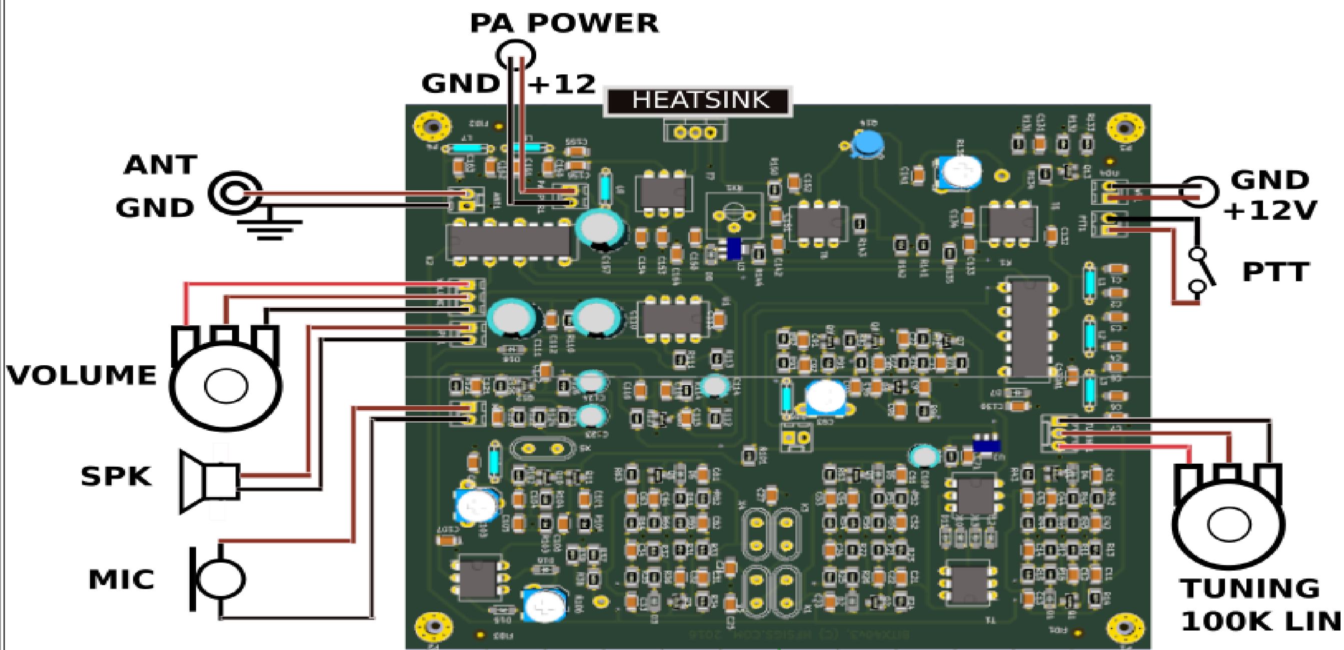
So when contemplating any project you really do have to think inside the box and what long term decisions must be considered before drilling that first hole or making the first metal cut.

The Initial Fit Check and Wire Job

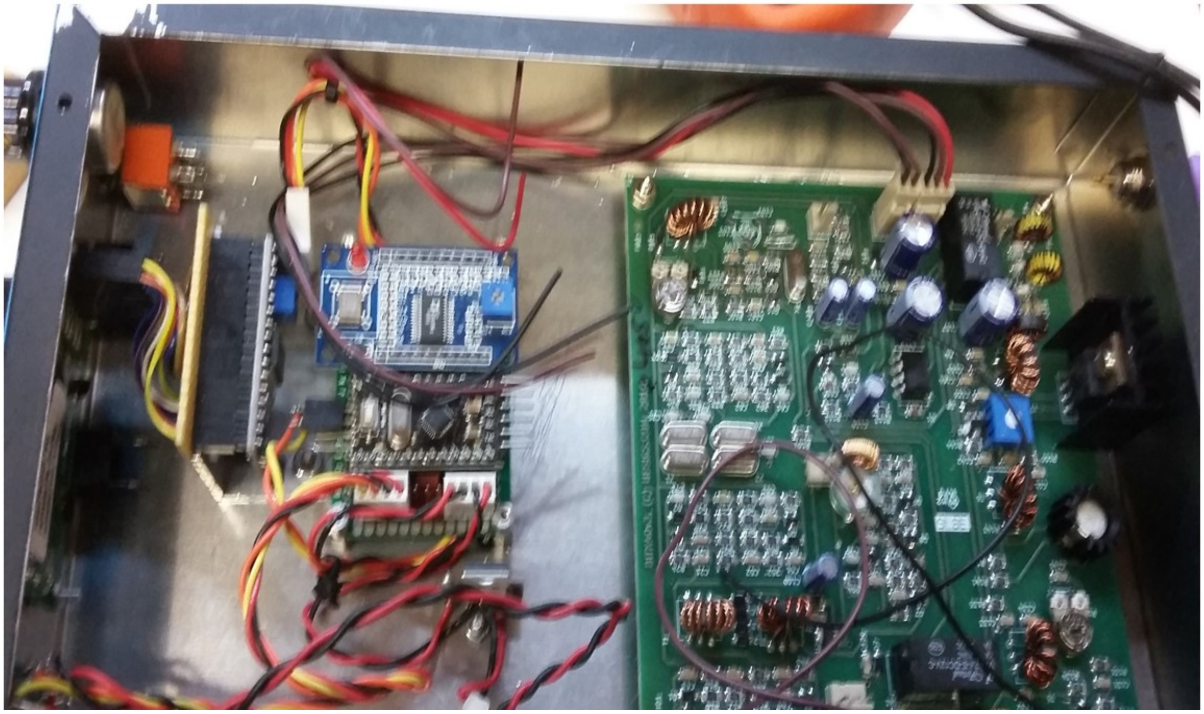
Before starting any wiring it is really a good idea to A) have some wiring standards and B) have good wire from the git go. Lets cover wire first. AVOID using wi is unsuitable and not very good for use with this project. For signal wiring I like to use #26 plastic covered and have adopted a color scheme which I will detail sl places like All Electronics . For power wiring you want something like number 18 as that is good for most power levels up to about 10 watts.

Wiring standards can be a huge benefit if you are troubleshooting a problem. In general I use the RED and BLACK leads for power and ground. For all circuit use ORANGE colored wire. On the transmit side I use YELLOW. For any bias circuits I use GREEN. If I am wiring a pot I will twist the wires together and BROWN. Brown goes to ground and White goes to the top end and Blue is always the center wiper. That is easy to remember and saves invaluable time.

With the Bitx40 project wired cables and connectors are provided. Fortunately VU2ESE has a standard in the black is ground and brown is the hot side. In connectors used with the audio gain control, brown is the center wiper and the red lead is the top end of the pot. VU2ESE has provided a pictorial wiring schemat



It is obvious to manage the wiring that you will need those cable ties that were linked to in one of the earlier phases.

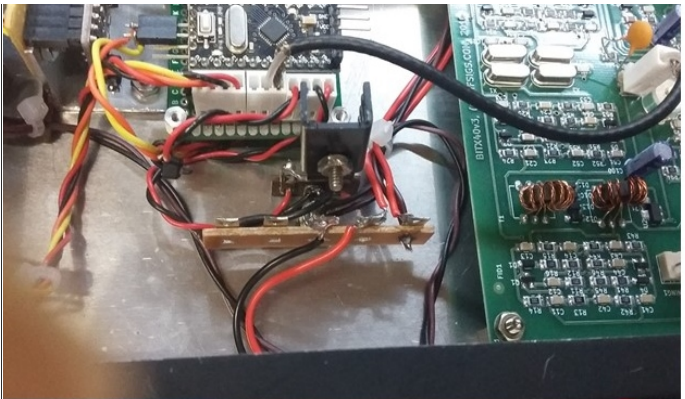


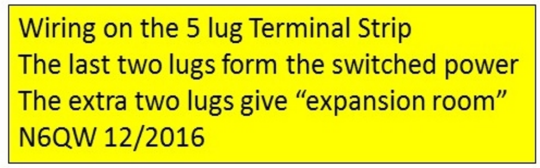
Scary as it may seem I frequently use pin headers on prototype boards and connect to those pins using header connectors. You can see these on the VU2ESE bo VFO board. There are many types; but it is always good practice to use what is called the "locking type". Basically there s a "tang" on the locking connector board mounted pin header locking it in place so it will not simply come loose. The connectors are also polarized so it is a near impossibility to put the connecto avoid smoking the board --notice I didn't say eliminate but avoid. You will have enough problems without having connectors coming loose from boards. Here ar connectors. (The P/N's below are for the two pin type.)

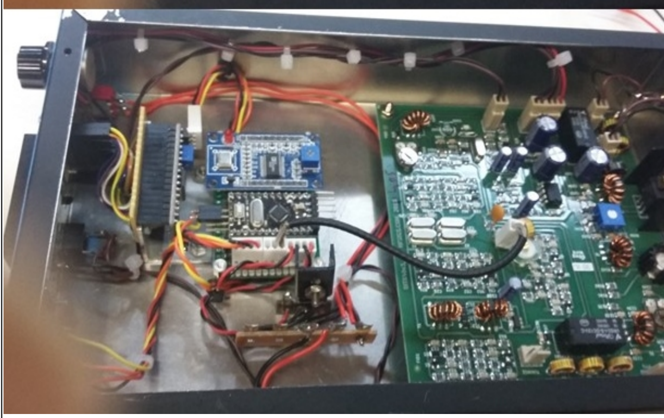
- **Jameco female housing with locking tang and polarized (prevent jamming in the wrong way)**
- **Jameco straight friction lock headers**
- **Jameco crimp terminals for the female housing**

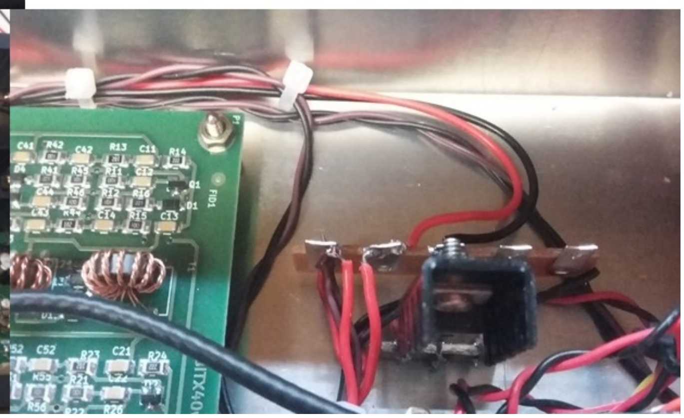
The items above are called crimp type and can be easily installed on the #26 wire using needle nose pliers. I am a firm believer of adding just a bit of solder to always rely on my crimping skills. With a bit of practice you can do it. No excuses about age or eyesight --get a headband magnifier and good needle nose pliers.

Below is photo of the completed wiring of the Bitx40 and look closely at the notes about how I did it. Noteworthy is that I liberally used cable ties to neaten up he







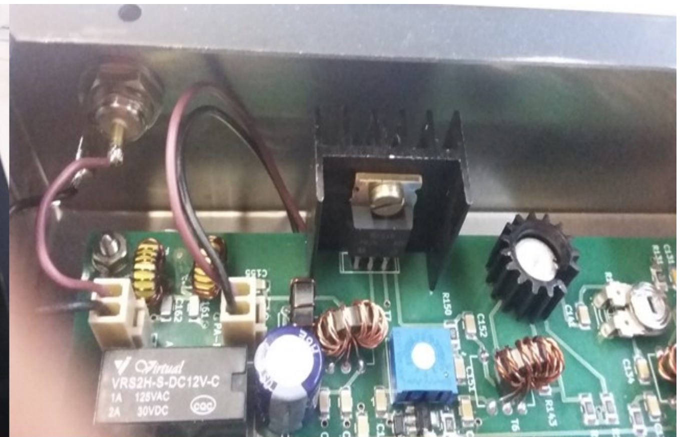


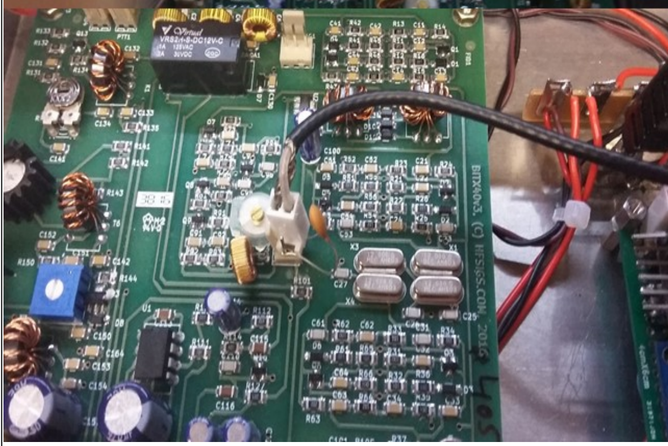
*** I used the cables supplied with the kit and only found it necessary to cut one cable and that was the one that connects to the antenna. VU2ESE is adamant th shall be no more than 2 inches long! Using the 6X10X2 chassis and positioning the board as I did the cables were almost the exact length needed. So that is indeed**

*** A word here about power connections and the ON/OFF switch. I recommend the use of two 5 lug terminal strips that are secured with a single bolt and include the two are connected facing each other is that one of the strips will be used to connect a 9.0 Volt (LM7809) three terminal regulator which will supply power to th you use a homebrewed version and the second terminal strip is used to connect power to the Bitx40 Board and power to the Arduino/AD9850. The hot lead fron terminal is brought to one lug and the ground lead is soldered to the ground lug. A wire from the hot lug goes to the panel mounted min-toggle switch and the toggle goes to an adjacent open lug. Thus power from the power connector is routed through the power switch to the radio and Arduino/AD9850. Now for my i connections made to the switch lug. One connection goes to the Vin of the three terminal 9 Volt regulator, and the other two connections go to the Bitx40 board. goes to a two pin header located in the upper right hand corner of the board. There is a second two pin header located near the IRF510 and in the proxin connector. With 12 volts applied to this second header the Bitx40 can pump out close to 7 watts. This is how I have it connected. But you can also apply 24 Volts second separate supply and now the Bitx40 can Pump Out 20m watts! Hey we are smoking here. CAUTION --the IRF510 on board heat sink is only good for 5 w power you must really up sized the heat sink. One possibility if you locate the ma inboard where I have located it is to get a copper spreader and using an TO-22 IRF510 to the copper spreader which is then bolted to the aluminum case. This will dissipate the heat generated at the higher power. It is suggested you locat before locating the ma inboard. The second CAUTION --simply do not connect the power cable to 24 VDC! While the IRF510 can take the 24 VDC the other circ smoke the board.**

*** The next wiring involves the connections to the header that can be used to introduce the external DDS (or PLL) Local Oscillator signal. When using the varcato in the above pictorial diagram. I found the varactor option only suitable for initial verification that the radio is working. There is just too much drift and dif fingers like mine). So make life easy a purchase the $14 digital VFO option and call it a day. Normal operation with the external digital VFO requires the disco which effectively removes the varactor tuning option from the mix. In the case of the $14 add on "Digi" VFO there is isolation in the form of a blocking capacito almost in the center of the board provides access to the base of the first stage of the on board VFO. If you connect directly to this without the blocking capacitor situation I bought the board before the Digi VFO was available and I made my own DDS. It did not have the blocking capacitor and thus I initially had the pr below shows how I temporarily offset my connector and have a patched in 10 NF cap. Later I will install the 10NF on my Arduino/AD9850 board and then just si**

*** VU2ESE has done a great job in including all of the parts to make this a working radio! Included in the $45 is an electret microphone element and even a smal good news --so now what do you do with it? I took a defunct microphone case that had a thin diameter cord on it. On the plug end I installed a 1/8 inch stereo p nicely. The microphone case I modified by inserting a small piece of plastic into the face of the microphone. Make it a snug fit! In the center of the plastic I drille tail file carefully enlarged the hole until it was just slightly smaller than the diameter of the supplied electret cartridge. It should be a snug fit. I carefully pressed and called it done. For those who screw up and make the hole too big --that is why they invented super glue. Prior to inserting the cartridge into the plastic. I that as you speak some of the air would flow past the cartridge. The photo below shows the completed microphone. The Microphone had a PTT already instal supplied tactile micro switch.**





***This completes wiring except for the power plug which comes supplied. I used #22 Red and Black wiring for the internal power runs. I did the same for the about reverse polarity protection. N2CQR has posted information about how to do this on the hfsigs.com hacks page which can be accessed through the Invariably no mater how careful you are you will get the leads switched and smoke the rig. I like to use a diode and relay so that the power feeding the rig is contact. If you have the leads reversed the field coil will not energize and no power is applied.**

Purists and people whose only goal in life is negativity will pan my solution as wasting power energizing the field coil. I suppose if you will operate from the batteries you don't want to waste watts closing a relay contact. A solution is to use a power FET. But hey I had a diode and relay in the junk box!

Phase 7 ~ Adding the Arduino/ AD9850 DDS

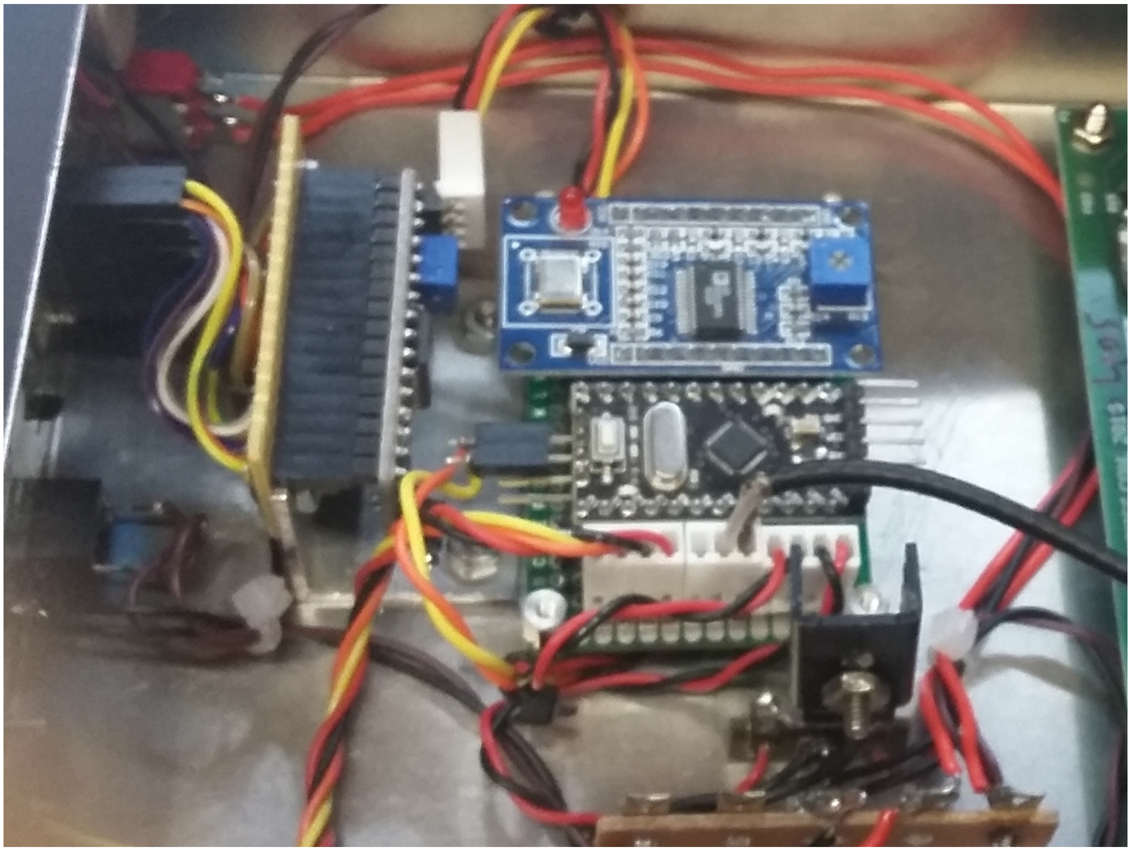
Added: Code for the OLED + Si5351 PLL

When this project was started I saw this part of the project as being the most difficult since it now has shifted from the realm of analog hardware to digital hardware and arcane software. Moving to the Arduino presents some obstacles especially to Old Timers (OT) such as myself whose exposure to digital electronics is of recent vintage.

But VU2ESE has solved the problem with his add on kit that costs $14. You get the hardware already built and it is a simple connection to the main Bitx40 transceiver board. He even suggests that there will be software that eventually can be added that will do more than just give you an accurate frequency generation and readout. Dual VFO's and SWR measurement are but some code that will soon be developed.

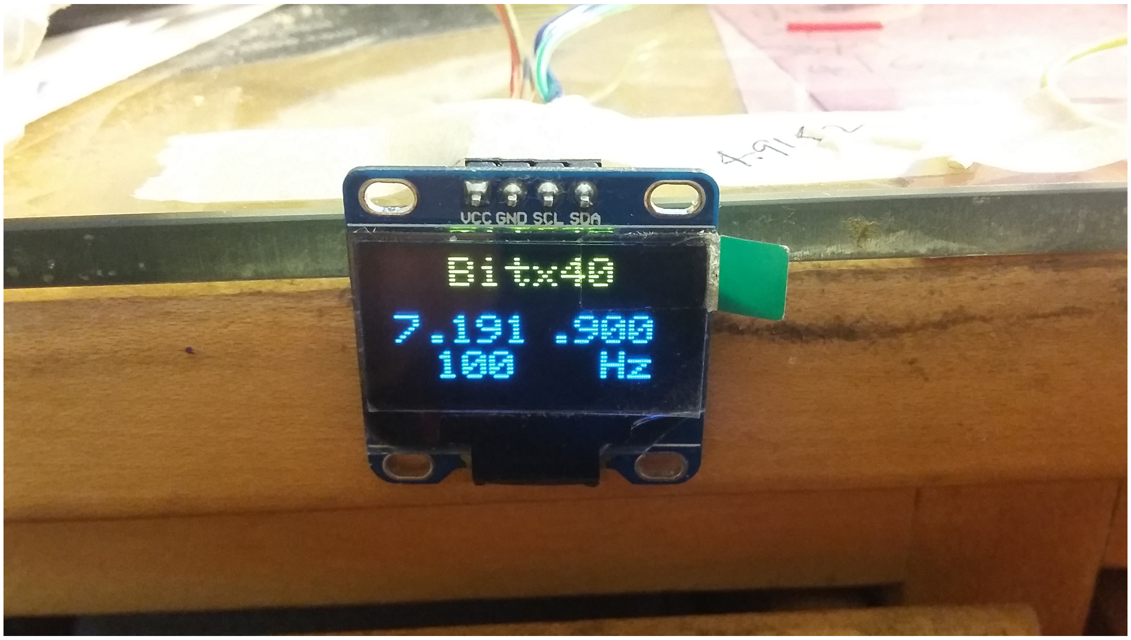
My Arduino and AD9850 code gets you the frequency generation and readout and that is it. Thus I will not be detailing here what I did but advise the reader to buy the VU2ESE board. By the way --my hardware cost more than $14 so that is another factor. Sure I developed the solution on my own; but that only was because the additional board was not offered at my time of purchase.

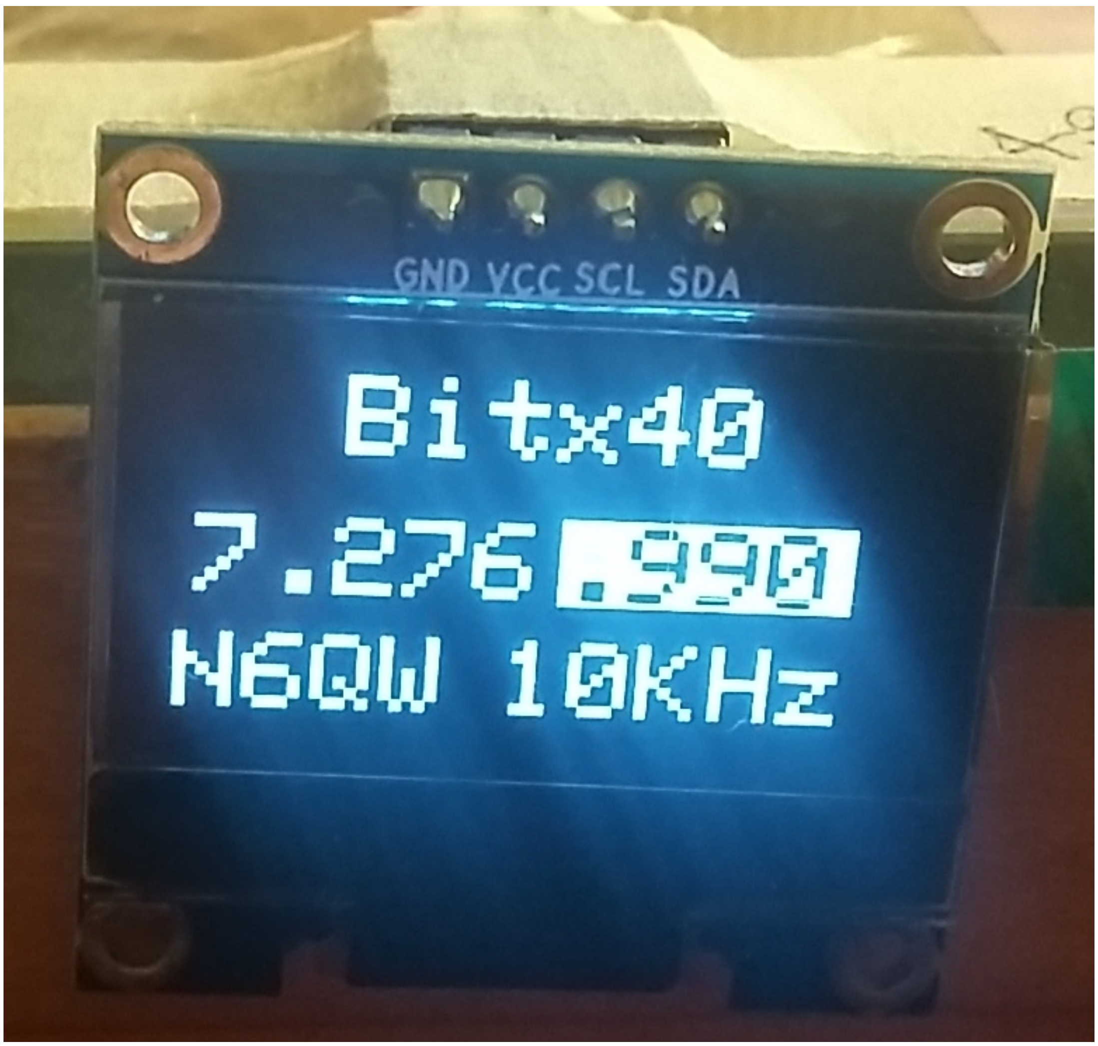
Size is another issue and a quick look below shows that my DDS takes up a lot of space. The "Add On" board is but a fraction of that size. So those wishing a compact rig tilts the decision even further to the add on board.



The VU2ESE board uses the Si5351 PLL (Phase Lock Loop) Clock Generator and is capable of generating three separate frequencies. Thus his board can generate not only the Local Oscillator (LO) but also the BFO (Beat Frequency Oscillator) frequencies. So another possibility is to remove the BFO crystal and use the Si5351 to generate the BFO and then you would have the ability to switch sidebands. While the convention has been to use LSB on 160, 80 and 40 Meters, the convention on 60 Meters is USB as is for 20 Meters and above. VU2ESE mentions the possibility of using the board on other bands, so the frequency agility and the BFO capability --all for $14 makes it a clear choice.

Notepad Text of Arduino Sketch
Si5351.h
Si5351.cpp
Rotary.h
Rotary.cpp
LiquidCrystal_I2C.h



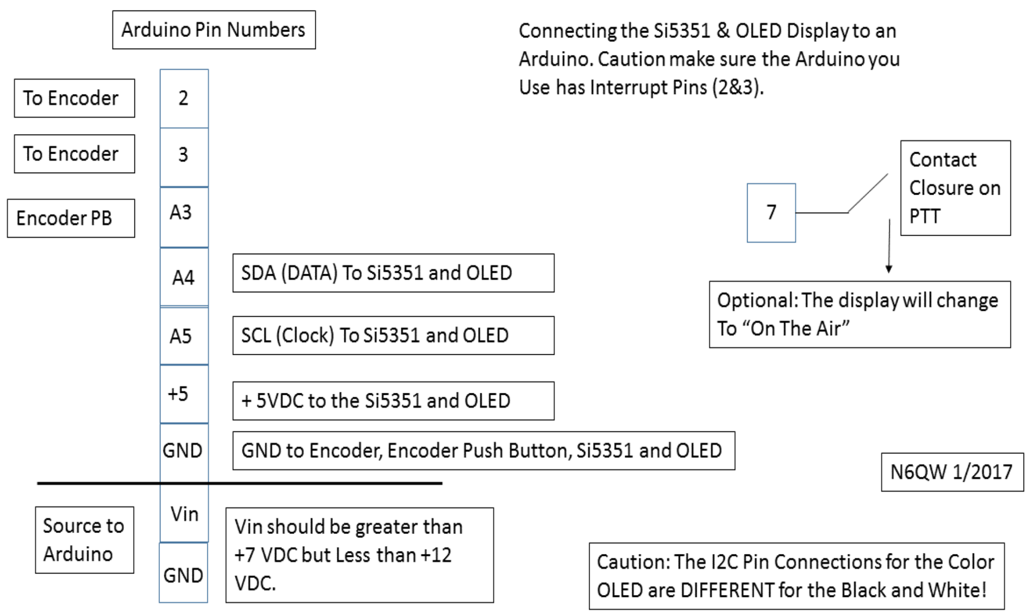


OLED Display Option for the Bitx40 project!

OLED_BITX40 Arduino Sketch

Video of the Bitx40 with Si5351 & OLED

Below is a "paint by the numbers" wiring schedule of how to wire up your Arduino to the OLED, the Si5351 and the Encoder. An alternate is provided for those who want to have the line "Bitx40" change to read "On the Air" during transmit. This has no operational value other than to add a "cool factor" to your Bitx40.



If there is a desire to delve into the hardware and software I used then contact me at N6QW

Teaser

A Color TFT Implementation for the Bitx40!

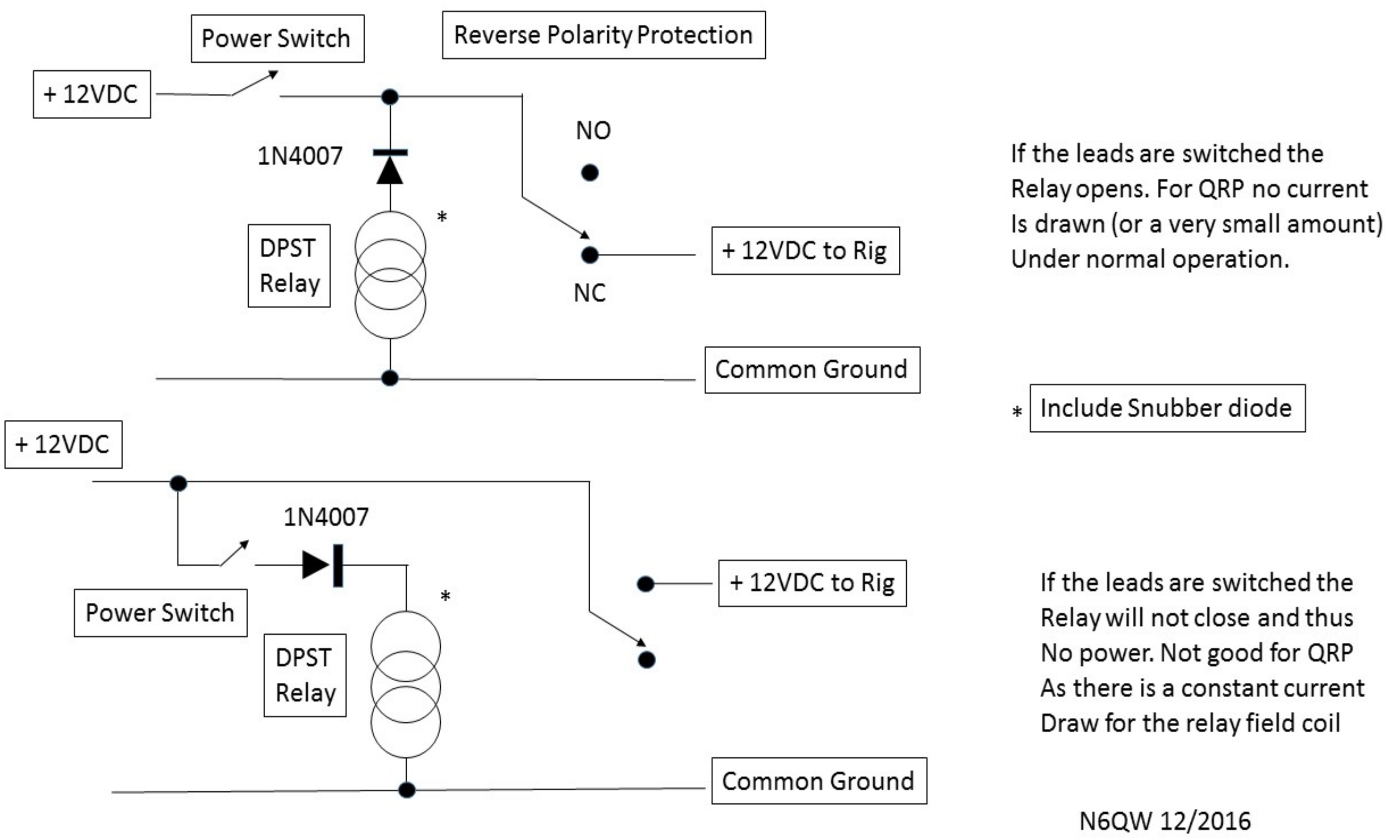

7.200.000
10 Hz
LSB
N6QW
The Bitx40 QRP SSB XCVR

Phase 8 ~ Hacking the Bitx40

One of VU2ESE's goals was that the Bitx40 would be an experimenter's platform when the builder would be encouraged to test drive new add on's or other ancillary circuits.

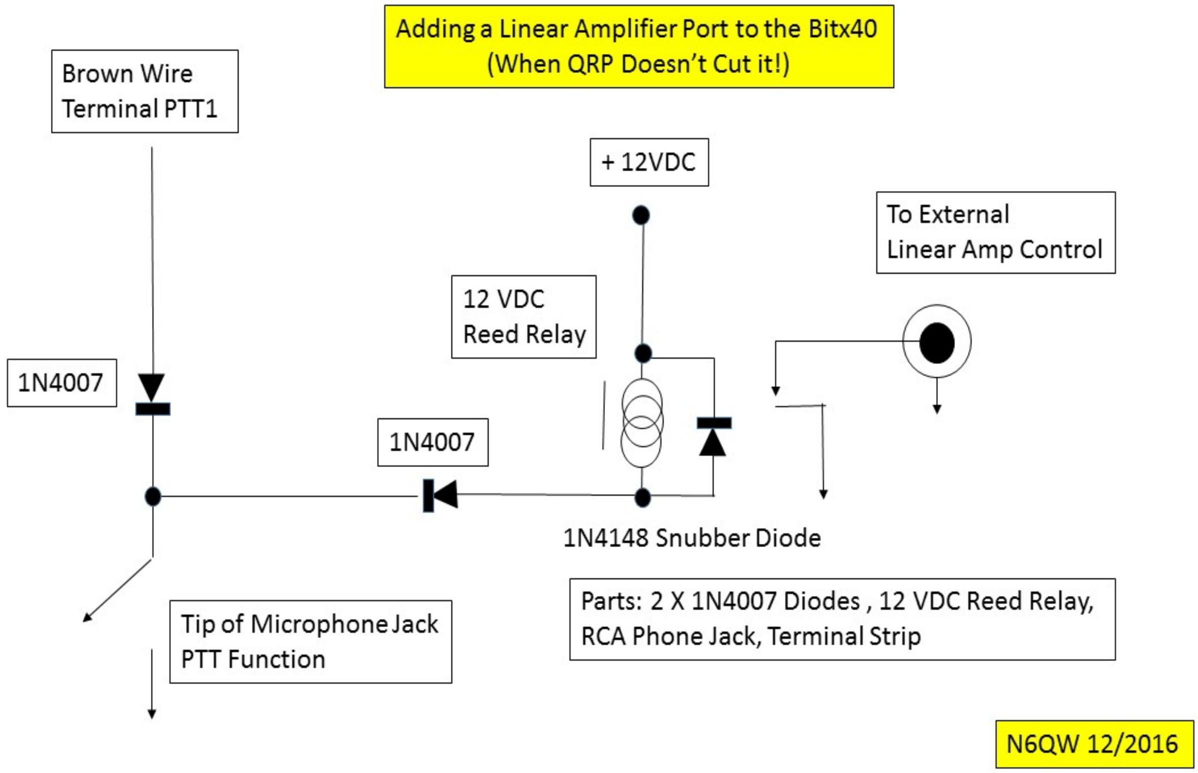
The first hack that I did was the Arduino +AD9850 DDS VFO but the new add on board gives you the digital VFO capability. This now obviates the need to provide detail on that hack. If you have a burning desire to find out how I did it then send me an email to N6QW

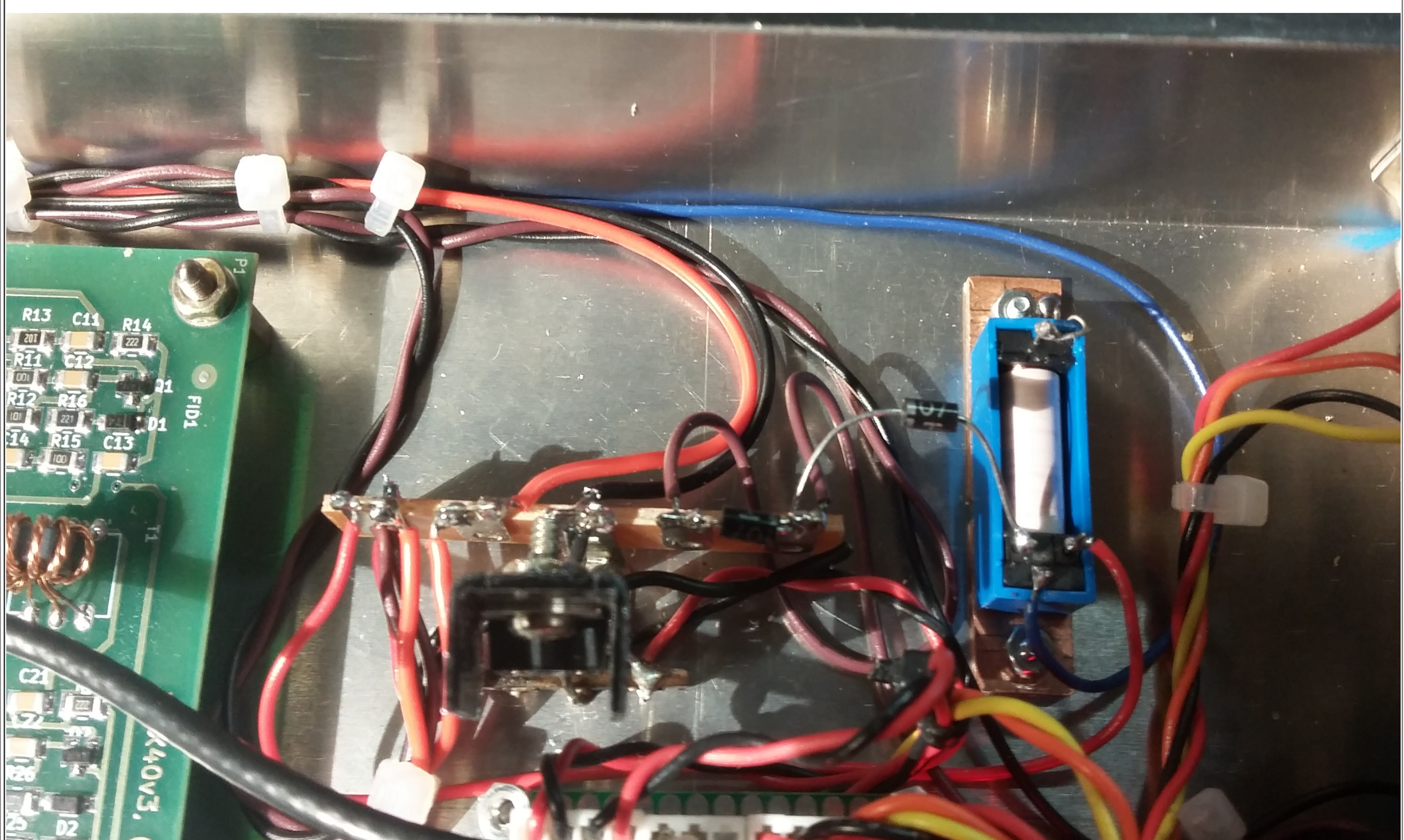
There are two worthwhile hacks that I developed aside from the Arduino driving an AD9850 and those encompass reverse voltage protection and controlling an external linear amplifier.



In the case of reverse polarity protection my preference is the second unit where the relay coil must be powered in order to provide voltage to the radio. The wrong polarity will keep the relay open!

Next is the controlling of a linear amplifier so that your 5 watt signal will be heard! This circuit involves just a few simple parts but has been built and tested by me so I know it works. The two 1N4007 diodes isolate the amp control from the rest of the Bitx40 radio.





The blue encased device is the 12 VDC Reed Relay available at your local Radio Shack. Note the two diodes that are installed on the terminal strip. One end of the Reed Relay Contacts is simply soldered to the base copper PC board which is at ground potential. The blue lead goes to the RCA jack mounted on the rear panel. One end of the 12 VDC Reed Relay coil is connected to +12 VDC and the other connects to the anode end of the 1N4007. Not seen is the 1N4148 'snubber" diode which is a 1N4148 connected across the coil with the cathode connected to the +12 VDC side of the coil and is a part of the back emf reduction /prevention.

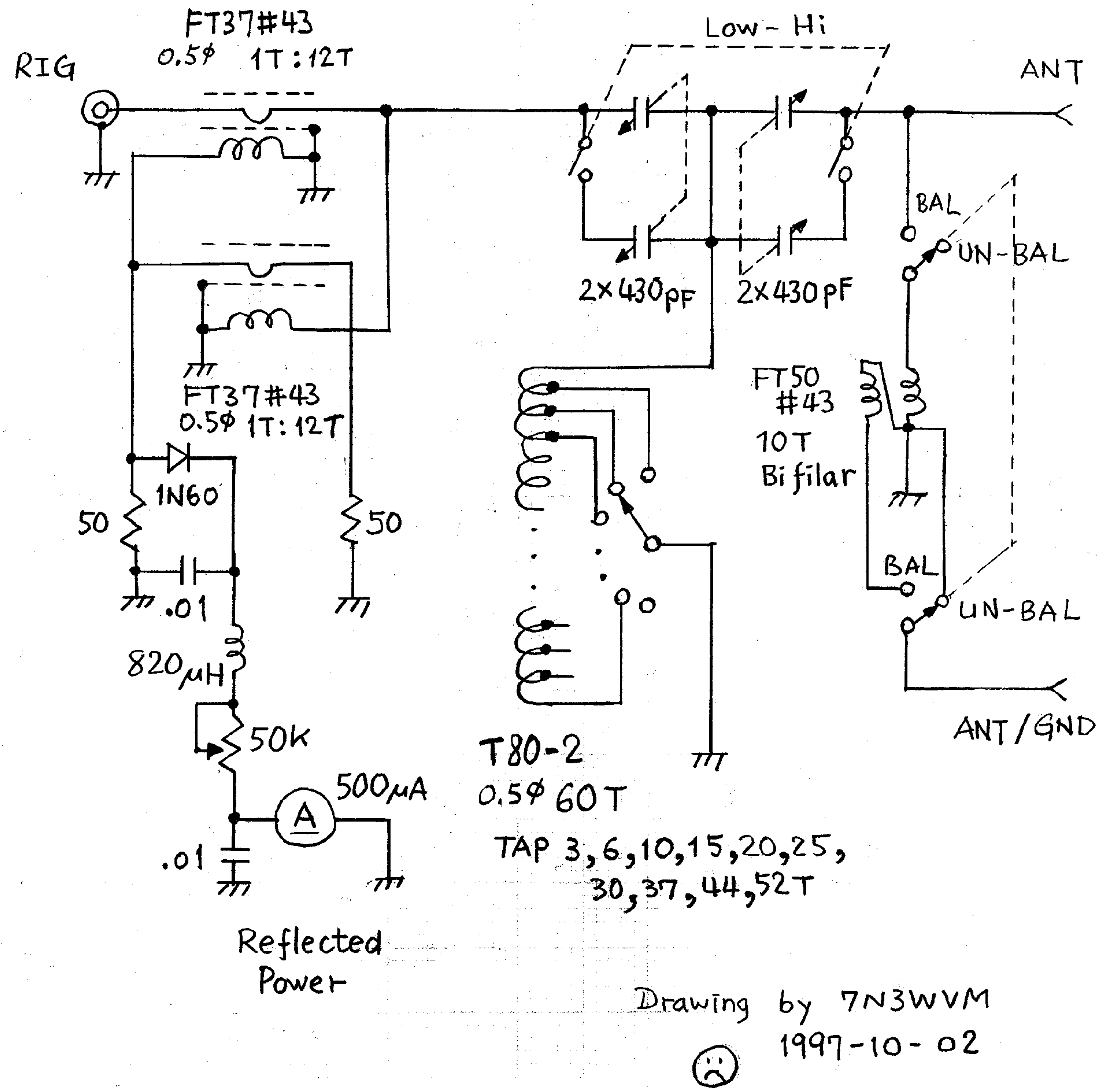
VU2ESE's web page on http://hfsigs.com has a hacks page and that should be read as well.

Homebrew CLC QRP Antenna Tuner

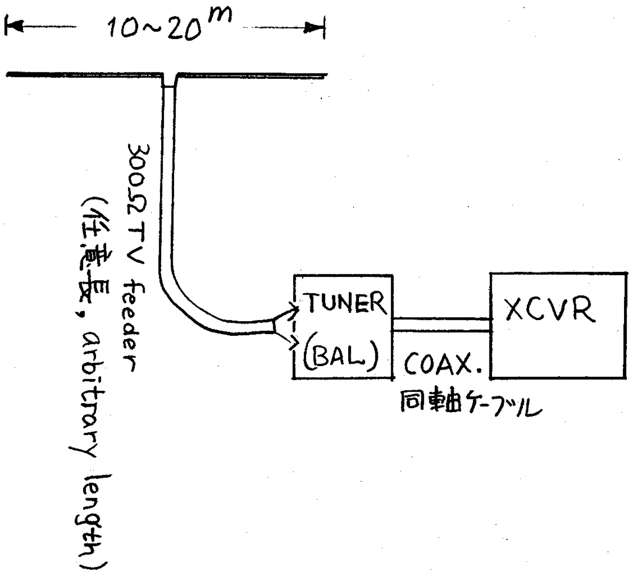
Cryptic letters are codes for Japanese / Chinese characters. English readers may skip them

. Meters that indicate the power of reflected waves are included. Adjust so that the reflected power is minimized. Since the output of my radio is originally known, the power indication of the traveling wave is omitted. Polyvalicon is made up of two coils with twelve taps wound on a toroidal core. As the balun is built in, you can connect unbalanced antenna or balanced antenna as shown below.

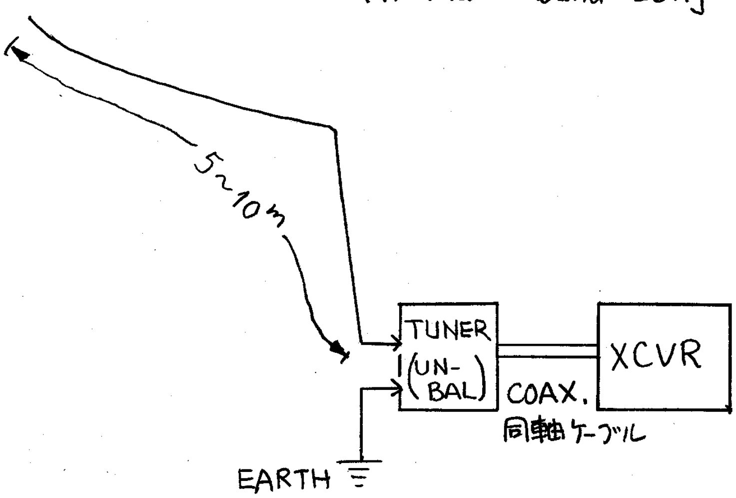
Two plastic-variable capacitors and a twelve-tapped toroidal inductor are used. Either unbalanced or balanced as can be shown in the bottom of the bottom. This design is very similar to that of St. Louis Tuner.


FT37#43
0.5φ 1T:12T
RIG
Low - Hi
ANT
2×430pF
2×430pF
BAL
UN-BAL
FT37#43
0.5φ 1T:12T
FT50
#43
10T
Bifilar
1N60
50
50
.01
820μH
50K
500μA
A
.01
BAL
UN-BAL
ANT/GND
T80-2
0.5φ 60T
TAP 3,6,10,15,20,25,
30,37,44,52T
Reflected
Power
Drawing by 7N3WVM
1997-10-02

HF Multi-Band Dipole



HF Multi-Band Long Wire



Drawing by 7N3WVM

1997-10-02

MINOWA, Makoto
7N 3 WVM
Last revised 1997 - 10 - 02 .

Low Voltage (12VDC) Two Tube Regen Receiver Using "Space Charge" Technology

Before I go into the details, let me say that I've built about 1/2 dozen one and two tube Regens over the years (and several superhets) and this one is by far the most selective, most stable, and easiest to use Regen. The 12AL8 and 5687WB or 7044 tube combinations work well, as does the 12AL8 and 5814WA (12AU7) combination with the plate voltage reduced to around 8V. Copying CW and SSB, as well as AM SW stations is easy. I have not had a chance to try more of the MANY other dual triodes like the 12AT7, 12BH7A and they may all work as well. I'll expand this write-up as other items come to mind. There will be a low voltage (24V ? 48V ?) CW transmitter to follow.

This was a fun project and all started when I was looking for low voltage designs for a Regen Receiver and matching Transmitter. Several of the guys on the Glowbugs (GB) Reflector reminded me of "Space Charge" tubes developed in the 60s to make car radios which did not require vibrators (used a power transistor for output). Their use was short lived with the advent of fully transistorized radios. The concept was actually invented in the 1920s but I don't know how widely it was used.

Normally, tubes operate with hundred(s) of volts of plate potential or around a hundred volts for battery tube sets. To ask them to work at very low voltages, something has to change because the lower cathode to plate potential is just not enough to enable enough current flow. The other problem is that the plate curves appear to become very non linear at low voltages. One method of improving the electron flow is to change the spacing and physical design of elements inside the tube. Another is to "boil" more electrons off the cathode by increasing the wattage of the filaments through redesign. A third is to place the 1st grid at B+ potential, thereby providing a nearby "pull" on the electrons from the cathode. Since it is a "grid", many of the electrons reaching the 1st grid zip right on through. The second grid (screen) is used as the "control grid" and the B+ charged plate gathers up the electrons. There is no suppressor grid.

The disadvantage of these low voltage tubes is that they consume lots of 12V power, which for a car radio, does not matter. For example a "normal" dual triode, miniature tube, may draw 150mA of filament current ......these may draw 350mA. The "space charge" Tetrodes may draw 500mA+ filament current. In addition, the Power Tetrodes with grid 1 tied to B+, may draw 70mA on the grid (not useful power, not input controlled) and half that on the plate (input controlled and useful). While this makes them very safe to use from a voltage standpoint, it does generate heat and they do get HOT. The reduced spacing between elements increases inter-electrode capacitance which reduces their usefulness at RF frequencies but they work well at AF frequencies. While all this is required in the "POWER" sections like the AF amplifier, it's NOT necessarily required in the low power VOLTAGE amplifier sections like the RF/IF Amplifier and the Detector in a car radio, or any other radio for that matter.

DESIGN CRITERIA:

- **NO VOLTAGES ABOVE 14VDC ....anywhere**
- **Power by: 12VDC wall wart, 13.8VDC power supply, 12V gel cell, 12V car battery**
- **An RF amp for isolation to prevent unnecessary radiation**
- **Allow for some design experimentation so it's both a useful radio and "test bed"**
- **Allow for both 9A and 9H based dual triodes**
- **Bandswitching, no plug-in coils, no extra parts to get lost**
- **Ham Band only focus via good bandspread tuning capability, will cover SW**
- **Smooth tuning, sufficient volume, and less critical Regen adjustment**

- **Incorporate many of the design "Do's" from the Regen experts**
- **Something different .....but for good reasons. Not a reproduction of someone else's radio. "Interesting"**

Basic Regen design is pretty common, so BEFORE the schematic comes the "concept stage", the "what's available in the junkbox stage", back to the "concept stage", followed by the "mechanical/electrical layout stage", then sketch a rough schematic ......and do it all over again. Paper/Computer layout is cheap.

After researching the "space charge" tubes, it was decided to go with the 12AL8 triode/power tetrode combination. These tubes are readily available and I found some NOS for $2 or $3. The Sylvania specifications for the tube (available online) also show a handy audio circuit which I used .....after a few modifications. It uses the triode as an AF voltage amplifier feeding the power tetrode.

For the Regen and RF amp, I looked for dual triode tubes likely to "boil" electrons with higher filament currents. The first ones found are "computer tubes" the 5687 and 7044. These are said to also be very low noise types ? I don't know relative to what. The 5687s are more readily available since audio guys use them, but both types are available NOS for $2 or $4. Since there are MANY dual triode miniature tubes out there (12AT7, 8414, 12AU7, 12BH7A, 12BY7, etc), why not make the design able to use as many as possible ? The two basing diagrams most frequently seen are 9A/9AJ and 9H, so why not a switch to change between the two pin configurations ? Turns out, only the plate and cathode of one triode section require change. I used the "stable" triode for the Regen section and the switched triode for the RF amp.

The other thing to keep in mind is that the requirement for "more power" is true in the "power" sections like the AF amplifier, but it's not necessarily true in the voltage amplifier sections like the RF amp and the Detector. What you are looking for there are good low plate current/voltage characteristics (curves). Tubes like the 12AU7 and its ruggedized 5814WA work fine ....with reduced plate voltage. The advantage of these tubes, over a 5687WB or 7044, is that you save 300mA of filament current and reduce the total Regen power from 1.1A to 0.8A.

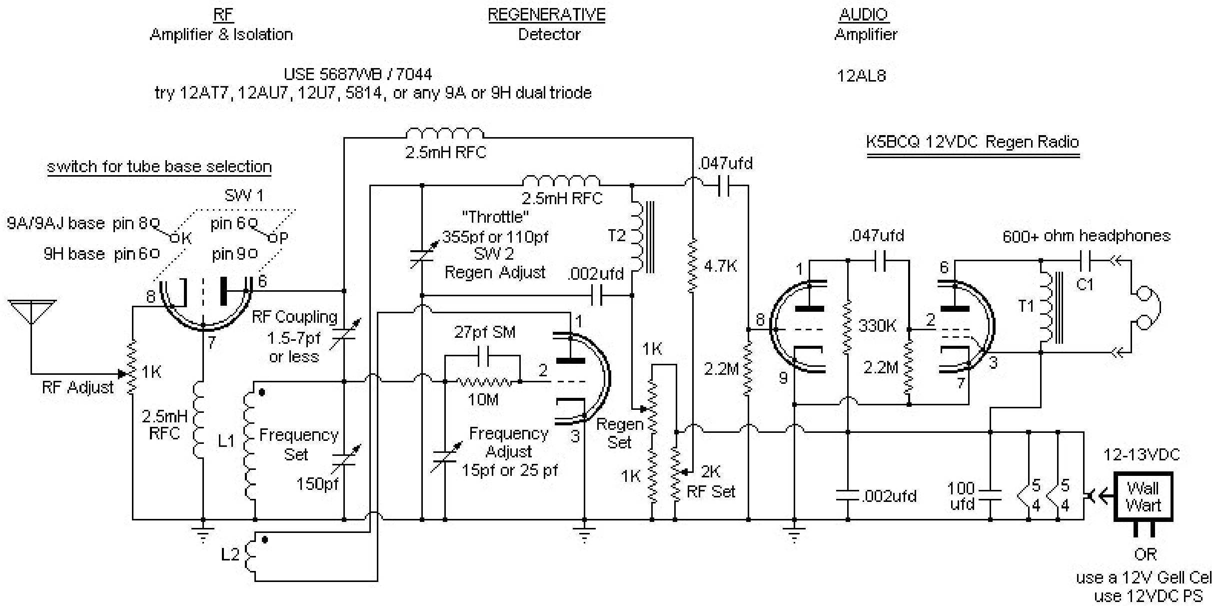
The coil and tickler were wound on a ceramic ARC-5 Tx oscillator coil form. Any circuitry associated with the Regen section should use ceramic where you can, short leads, stiff wire, good wiring practice. If you take a look at the pictures, the wire going to the "Frequency Set" and "Frequency Adjust" capacitors is #18 solid wire suspended --OFF-- the chassis. This reduces the capacitive changes caused by slight wire movement. The capacitors are VERY solidly mounted to BOTH the front panel and the chassis.

CONTROLABLES (L to R):

- **Front Panel: Frequency Set (150pf), Frequency Adjust (15pf), Regen Adjust (355pf or 110pf "Throttle" capacitor) , RF Adjust (1K), Regen Set (1K, 6-12V) , RF Set (2K, 0-12V)**
- **Top Chassis: Bandswitch Select (2.5-6Mhz, 6Mhz-13Mhz, 13Mhz-22Mhz, RF Coupling (1-7.5pf), Tube Basing Select (9A or 9H), Throttle selection (550pf or 110pf)**
- **Rear Chassis: 12VDC wall wart socket, 12VDC terminals, BNC antenna connector**

OPERATION:

- **Power should be held to 13.8VDC Max. The consumed current will go up with increased voltage and shorten tube life. The Regen uses about 1.1A with the highest current draw filaments. There is also a 100mfd capacitor across the power input so there will be an initial current surge over 1.1A to the cold filaments. This will settle down to around 1.1A (or 0.8A if using the 150mA filament dual triodes).**
- **Select the desired band with a jumper (see picture). If you are using the lowest band, store the jumper wire end inside the coil form.**
- **Set the "Throttle" capacitor to mid position, advance the "Regen Set" until you hear regeneration start, and use the "Throttle" to control regeneration.**
- **Use the "Frequency Set" to roughly tune in the signal and the main "Frequency Adjust" as the bandspread tuning.**
- **Minimize the "RF Coupling" for best selectivity, adjust volume with the "RF Adjust", and set the "RF Set" for just before cutoff (try, you won't miss it).**
- **If the 1K "RF Adjust" resistor provides any type of frequency "tuning", the 2K "RF Set" resistor is not set correctly. It's easy to turn the untuned RF amp into a "diode detector" and swamp the Detector stage with the strongest local broadcast station(s). It's also easy to re-adjust the bias correctly to make it an RF amp only.**



This is a homebrew project, use what you have, good wiring practice, stiff wire (18ga)
T1, T2 - Output transformer prmary from a tube type set (don't use transistor output transformer)
L1 - 31t, #22, 1-3/8" dia, 1-5/8" long, 20uH, whole coil 2.5-6Mhz, Tap1 9t, 6-13Mhz, Tap2 3t, 12-22Mhz (still working on Tap2)
L2 - 8t, #22
C1 - 5 to 10ufd Mylar or Tantalum (don't use aluminum electrolytic)
Use ceramic in high Q area (DETECTOR)..coil form (a damp toilet paper roll won't work), tuning capacitors, and detector socket
Some components are extra for experimentation (SW 1, SW 2, RF Set)
Adjust the coupling trimmer to the lowest useable value for better selectivity,1pf is good.
At these low plate voltages "electron pull", cathode to plate, is weak, try "electron pull and boil em' off" (hot filament tubes)
Did not want to use plug-in coils but that is an option for you (use a ceramic socket if you do)

Kees Talen
12/13/04

Schematic

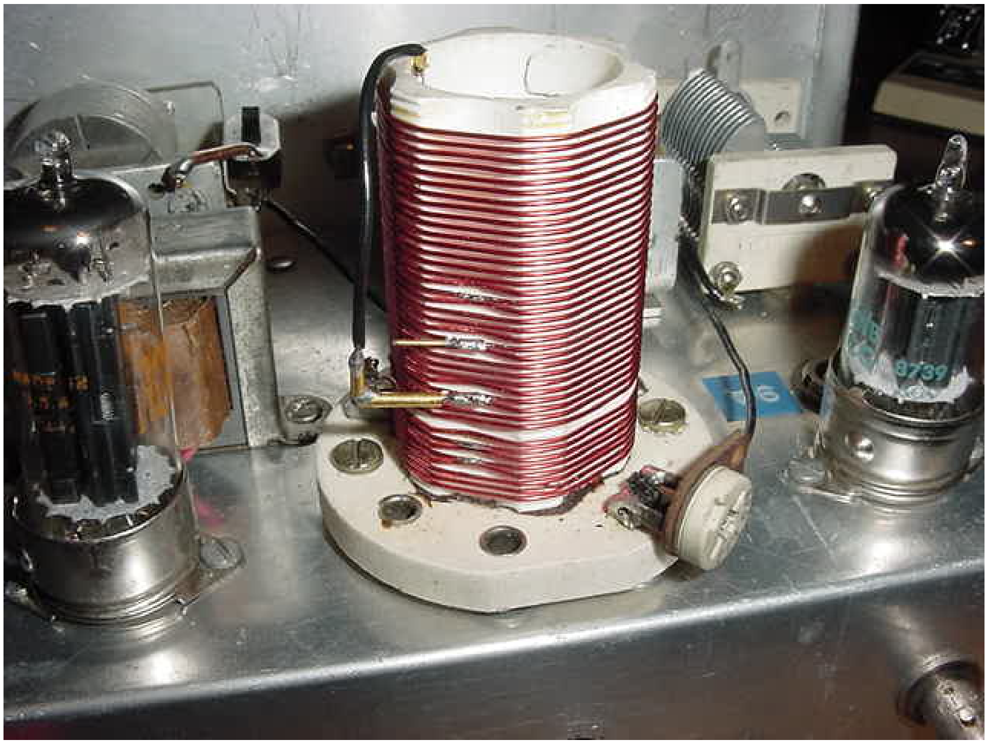
WHAT ? & WHY'D HE DO THAT (L to R) ?

- **Chassis size ...that's what I had. It's built on a used 5" x 7" aluminum chassis picked up at a swapmeet. The 5x7 has a nice aspect ratio, so the front panel is also 5" x 7". Also found a 7" x 7" used aluminum chassis which will be for the matching Low Voltage Tx (same type front panel).**
- **I wanted the grid of the RF amp to have ONLY the bias level established by the 1K cathode resistor on it, not any potential RF from the ground to "control" the signal, so a RF choke was added. You can also tie it directly to ground or through a x00K resistor but I believe the RF choke is better.**
- **A switch was added to allow use of both 9A base tubes and 9H base tubes. Since only one section of the dual triode was affected, that section was used for the RF amp. Would have preferred to use a ceramic switch but didn't have one and it's not necessary for the RF amp. DON'T add extra wiring to the Regen section if you can avoid it.**
- **The RF Coupling capacitor should be as small as possible and two short parallel wires (not twisted) works fine. You are looking for 1pf to 2pf optimum. In fact, just bringing the antenna close works.**
- **A x0K RF plate resistor was originally the only component between the plate of the RF amp and B+. Turns out, cutoff with 12V is at about 2-4K and that is not enough RF isolation so a RF choke was added on the plate side. Since the current draw is not that high, a resistor voltage divider was used to vary the B+ to the RF amp and to control cutoff. Again, this is to allow more tube substitution flexibility. Power consumed by the two voltage dividers is less than 1% of total power consumed.**
- **Use ceramic forms/sockets in the Regen section because of low loss (promotes high "Q"), and rigidity (promotes stability). Low B+ helps too.**
- **The grid R/C is 27pf (may try less) and 10M (may try more).**
- **Coil data is on the schematic and is pretty straight forward. You can see most of the detail in the pictures.**
- **The "Regen Adjust" Throttle capacitor has a switch to select between the 355pf section and the 110pf section. In fact, the contacts were extended and it now has a middle position which selects both for 465pf. This is largely for experimentation and only using the 355pf unit or the 110pf unit is fine.**
- **Notice in the pictures that the wiring in the Regen section is with large solid wire for rigidity. The Regen section wires are routed away from the chassis and other metal as best can do, to lessen capacitive effects (IMPORTANT). A bouncing wire 1/16" from the chassis has MUCH more effect on frequency than a bouncing wire 1/2" from the chassis.**
- **The "Regen Set" control was added because the feedback could not be controlled on the higher bands with the fixed 8t tickler coil and to allow more tube substitution flexibility. Ways of reducing feedback are; less Throttle capacitance, fewer tickler turns, further tickler separation ....all of which were not options. I could put a variable resistance across the tickler, or add tickler taps, or I could vary the voltage. Turns out that a reduction of about 1.5V to 10.5V makes it work fine. In order to allow experimentation a 1K pot**

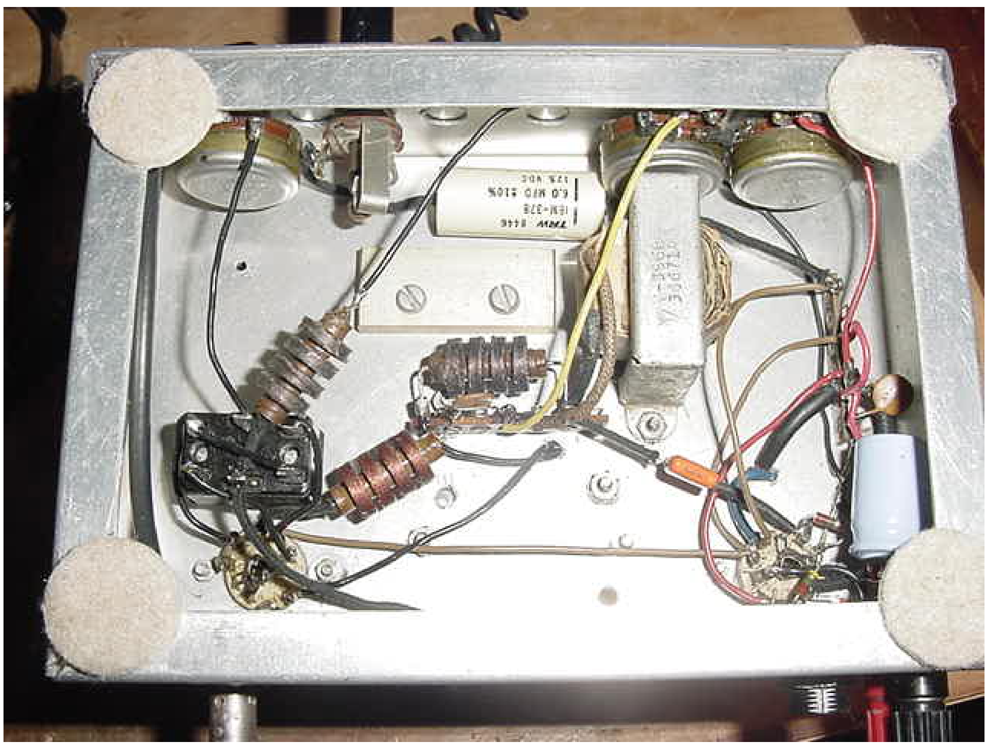
with a 1K fixed resistor were added to give 6V to 12V adjustability range. This comes in really handy when using tubes like the 12AU7, which seems to work best with 8V on the plate in this design (fixed 8t tickler coil). You can also use this as the Regen control but the Throttle capacitor is "smoother".

- **Didn't use tube shields because these puppies run HOT as is. The partial "shield sockets" are sufficient because they DO provide shielding in the critical tube radiation area ....the bottom of the tube envelope.**
- **T1 and T2 are both small tube type audio output transformer primaries (insulate and fold the secondary underneath). Choke coupling is used because I had the transformers and the plate load for the output stage is 800 ohms (didn't have a 1:1 audio transformer or a 800 to 8 ohm transformer). The military surplus headphones I have are 600 ohm and I prefer not to pass DC through them. Found out from the experienced guys on the Glowbugs reflector that can demagnetize them ....didn't know that.**
- **Old rule of thumb ...for audio circuits the coupling capacitor and load Time Constant (TC) should be about 0.02 to 0.1 for proper low end roll-off. In other words, a coupling cap of .047 and a grid resistor of 1M is "0.047" ....within the range. Notice that the values used in the resistance coupled AF section are .047ufd and 2.2M or "0.10" ....just fine. The headphones are around 600ohms and would require a coupling capacitor of 33ufd. Since we're not into Hi-Fi and don't need 10Hz response, 5-10ufd is perfectly fine for CW, SSB, and good AM. But .047ufd is NOT FINE. If the headphones are transformer coupled, there is no coupling capacitor.**
- **For audio signals, Mylar capacitors are excellent, poly capacitors are very good, and for higher values the tantalum capacitors are good, aluminum capacitors are bad due to the higher effective series resistance (ESR). I happen to find a 6ufd Mylar and used it.**
- **What's that big piece of metal underneath, under the tuning capacitor ? That's to make the mounting to the aluminum chassis more rigid. There are also mounting slots in the chassis to allow you to move the tuning capacitor forewords and backwards for alignment with the front panel.**
- **The tuning mechanism is out of my junkbox (don't know what it's out of) and uses a 6:1 Jackson Bros ball vernier and a set of anti-backlash gears. Tuning is smoooooooth.**

Top view showing adjustments



Coil bandswitch detail

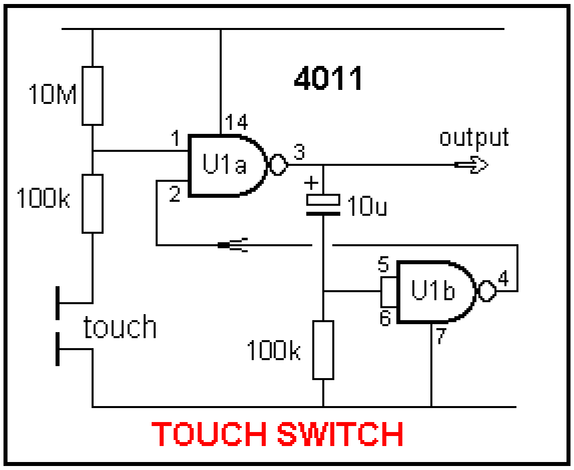


Underneath chassis detail

TOUCH SWITCH

A simple circuit to show the operation of a NAND gate.

Before reading the article, go to the two animations below and see how the circuit operates.

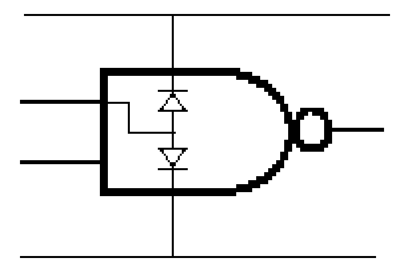


HOW THE CIRCUIT WORKS

The chip used in this project is a Quad 2-input NAND gate. It normally goes under the part-number
CD 4001 or HCF 4001 or simply "the 4000 family."
Only two of the gates are used. Read pages 11 & 12 of this course to see how a NAND gate operates.
The second gate in the circuit has both inputs tied together and this changes it from a NAND operation to an inverter (NOT gate). So, there is only one NAND gate and one INVERTER in the circuit.
When power is applied, pin 1 of the first NAND gate will be pulled HIGH by the action of the 10M resistor. The output of the gate will be worked out in a minute, we now go to the input of the second gate and see it has a **TIME DELAY CIRCUIT** connected to it. A capacitor and resistor connected in series is called a "Time Delay" circuit. It does not matter if we consider the output of U1a is HIGH or low. With any time-delay circuit, the capacitor will be charged after a period of time and so the voltage on the input of the INVERTER will be LOW.
This makes the output HIGH and the high is transferred back (called a FEEDBACK LINE) to the first gate. Thus U1a has a HIGH on both inputs and the output is LOW.
This is how the circuit "SITS" with the output LOW.
If a finger is **briefly** placed across the two touch pads, the voltage on pin 1 will go LOW.
The output of U1a goes HIGH and since the capacitor is uncharged, it takes the input of the inverter HIGH. The output of the inverter goes LOW and this is passed to input pin 2 of U1a. In effect, the action of the circuit is taking the place of your finger as far as U1a is concerned and you can now remove it from the Touch Pads.
The 10u electrolytic starts to charge and after a short period of time the voltage on the input of U1b goes LOW. This makes the output of U1b HIGH and this is transferred to pin 2 of the first gate.
If your finger has been removed before this "time-out," U1a will see two HIGHs and the output will go LOW. The fully charged capacitor will be discharged through a diode on the input line of the second gate and the circuit will sit in this state until it is activated again.

A LITTLE KNOWN FACT

A set of diodes is present on each input line to prevent the input voltage rising above or falling below the rail voltages.
Under normal conditions these diodes are "reverse biased" and do not have any effect on the operation of the gate.
But if the input voltage rises above rail voltage, the top diode becomes forward biased and


The input diodes

"clips" the input voltage to rail voltage + 0.65v above rail voltage. The same applies to the negative excursion. The input voltage is clipped to -.65v
This is how the electrolytic gets discharged. It discharged through the lower diode. When the output of the first gate goes low, the charged electrolytic will try to take the input(s) of the second gate to about -9v (if the rail voltage is 10v). But the lower diode on the input prevents it going more than -.65v and thus the electrolytic is discharged through it.
See the action of the capacitor by referring to the multivibrator animations on the previous pages of this course.

CIRCUIT OPERATION

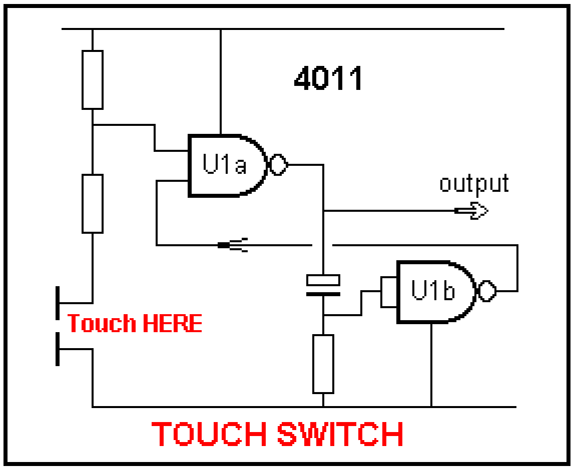
When a finger is placed on the "Touch Pads" (and removed very quickly) the output of the circuit goes HIGH, remains HIGH for a short period of time, then goes LOW. In other words the circuit produces a brief pulse when a finger touches the Touch Pads.
There are two animations for this circuit:
A: The first animation shows the operation of the circuit if a finger is kept on the touch pads for a long period of time. The circuit "times-out" but does not change state. This is **not** how the circuit is intended to be used. It only requires a brief touch of the pads for the circuit to operate correctly. Keep the mouse on the Touch Pads to see how the circuit reacts.
B: The second animation shows the correct operation of the circuit. Move the mouse quickly over the Touch Pads to see it operate.

In the first animation, the things to observe are:
1. Pin 1 goes LOW when a finger is placed on the Touch Pads.
2. Output of U1a goes HIGH.
3. Electrolytic is uncharged and takes input of U1b HIGH.
4. Output of U1b goes LOW.
5. Pin 2 of U1a goes LOW.
6. Electrolytic begins to charge.
7. After a period of time, input of U1b sees a LOW from the "timing circuit"
8. Output of U1b goes HIGH
9. Pin 2 goes goes HIGH but NAND gate does not change because a finger is on the Touch Pad is keeping pin 1 LOW.

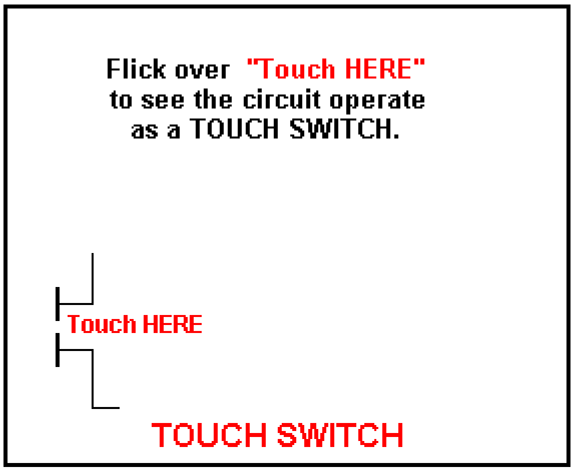
In the second animation, the things to observe are:
1. Pin 1 goes LOW when a finger is placed on the Touch Pads.
2. Output of U1a goes HIGH.
3. Electrolytic is uncharged and takes input of U1b HIGH.
4. Output of U1b goes LOW.
5. Pin 2 of U1a goes LOW.
6. Pin 1 goes HIGH when finger is removed..
7. Electrolytic begins to charge.
8. After a period of time, input of U1b sees a LOW from the "timing circuit"
9. Output of U1b goes HIGH
10. Pin 2 goes goes HIGH.
11. Output of NAND gate goes LOW.

THE "TIME DELAY" CIRCUIT

The capacitor and resistor make up a circuit known as a TIME DELAY CIRCUIT. When power is applied to the combination, the capacitor charges via the resistor and the voltage at the join can be monitored. The capacitor can be placed above or below the resistor and the **voltage at the join** will either rise or fall during the charging process. It does not matter if the voltage rises or falls, the end result is the same.
We are waiting for a **CHANGE** from LOW to HIGH or HIGH to LOW and the time for this to occur is the feature of the circuit.
The join of the time delay components (the point on the circuit where the capacitor and resistor meet) is monitored by one of the input lines of the NAND gate and in the Touch Switch circuit, the capacitor is above the resistor. This means the voltage will fall when the capacitor begins to charge. A point is reached where the gate sees a LOW and the output goes HIGH.



Keep your mouse on the Touch Pads to see the operation of the circuit if a finger is kept on the pads too long.



Flick over the TOUCH PADS very quickly to see the circuit operate

FACTS TO REMEMBER:

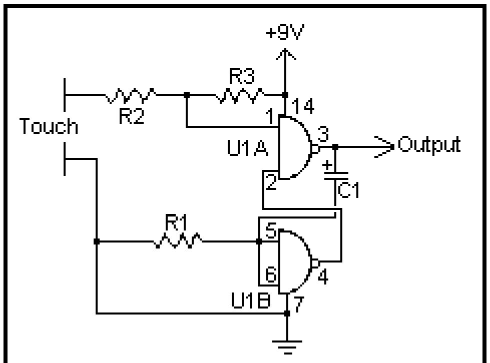
Basically there are two different types of DIGITAL GATES: TTL and CMOS. TTL gates have a very low input impedance (resistance) and CMOS has a very high input impedance. The end result is they both work the same i.e. the circuit has the came outcome, but the value of resistors and capacitors for the biasing and timing components is completely different. The difference can be a factor of 10 to 1,000 or more so you must design around "TTL" or "CMOS" and you cannot replace a CMOS NAND gate, for instance, with a TTL NAND gate without completely re-designing the surrounding components.
TTL chips require a small amount of current to drive the internal circuitry. CMOS chips require almost NO POWER to drive the internal circuitry. CMOS gates require less than a fraction of a micro-amp. TTL requires a milliamp or more for each gate.
When designing with CMOS gates, you can consider the input impedance of a gate to be infinity. In other words the gate does not put any load on the surrounding circuit.

In general, a gate changes state when the input voltage rises above about 55 - 65% of rail voltage. And when the voltage is falling, the gate changes at approximately 45 - 35%.
If the voltage is rising or falling SLOWLY, the output of a gate can flutter HIGH-LOW-HIGH-LOW during the time when the voltage is between 34 - 54%. This is called the INDETERMINATE zone and the voltage should **not** be kept in this region.
It takes a short period of time before a gate starts to flutter and during normal operation the voltage changes from LOW to HIGH **very quickly** and the gate does not have time to start to flutter.
In the Touch Switch circuit the voltage changes from one level to the other quite slowly. When a finger is applied to the touch pads, the voltage on the input of the first gate rises slowly **in digital terms**.
And the time-delay circuit raises the voltage on the second gate very slowly. This may causes

the gate to flutter and if this circuit is used to activate a device such as counter module, it may produce false triggering.
Unless you know the quirks of digital chips, you will wonder where the false triggering is coming from!
This is only a demonstration circuit and may produce multiple pulses.

WHY?

Why is it important to know how a circuit works?
Why do we go to so much trouble to explain the operation of a circuit?
The answer is simple. You may need to modify it, adapt it or interface it to another circuit. If you don't know how everything operates, it will be almost impossible to connect the two circuits together.
For instance, you may want to increase the time-delay of the Touch Switch. For this you need to know the components that create the delay (the 10u electrolytic and 100k resistor). Once you know the components, you can experiment with increasing or decreasing the values. You don't have to know the mathematics to arrive at the time-interval as five minutes of experimenting will produce the values but it is handy to know that increasing the value of the capacitor or resistor will increase the time.
Why is the layout of a circuit so important?
All the circuits we present in this course (and all our publications) follow a very strict code of layout so their operation can be quickly worked out. That's why we include all component values on the circuit. Anyone who draws a circuit without including the component values has absolutely no electronics appreciation at all.
Quite often the operation of a circuit is entirely dependent on the value of the components and if they are missing, or contained in a list of parts, it will take time to work out how the circuit works.
The whole idea of a circuit diagram is to be able to quickly work out if it is doing what you want it to do. And to do this it must contain as much detail as possible.



The Touch Switch circuit from the Web

As an example, this Touch Switch circuit is very hard to follow. The component values are not on the diagram and the layout makes it difficult to see how the two gates are connected together. If a circuit is laid out properly, you can "see" it working - just like the animation we have included above. Keep this in mind when drawing diagrams. Keep them simple, clear and easy to follow. This will help others to follow your circuits - especially when you have designed something new.
The main fault with the diagram on the left is the feedback line (from pin 4 to pin 2). It should be much clearer as it is extremely important in the operation of the circuit. In our diagram above, we have placed the two gates apart, with one gate feeding the other. Then the feedback line goes from the output of the second gate to the input of the first. The line is also marked with a "backward arrow" to emphasise the fact that signals on this line are travelling backwards.

WHERE ARE WE GOING?

We may have said it before, but the main aim of this course is to get you familiar with electronic components and "building blocks."
As far as gates are concerned, it is not necessary to go past the elementary knowledge as any complex gating situations are best handled with a microcontroller design.
This is the way we are heading with this course as electronics is changing rapidly and for less than $2.00 (in bulk quantities) you can get a microcontroller chip that will take the place of dozens (if not hundreds) of gates and do it all in an 8-pin chip!
It's all done by programming the chip and you can keep modifying the program until it works perfectly, without having to connect lots of gates together or even take up a soldering iron.
There are other advantages of a microcontroller. It is much easier to interface a microcontroller to the outside world than a digital chip. Everything on the outside runs too slowly for digital IC's and they create the effect known as FALSE TRIGGERING.
On the other hand, microcontrollers can be turned on for a very narrow "window" of observation and the information gathered in this way is very accurate.

Some chips do not have the problem of "flutter" when the voltage is rising and falling because they do not have an INDETERMINATE ZONE. They have a circuit on each input line that prevents the gate from changing state until the input voltage reaches exactly 66% of rail voltage. The input voltage must then drop to exactly 33% for the output to change back to its original state.
If the voltage swing is between 34% and 65%, the chip does not change state. This circuit is called a **SCHMITT TRIGGER** and the gap between the high and low trigger points is called the **HYSTERESIS GAP**.
This gap is not a problem when the chips are used in DIGITAL SITUATIONS as a digital signal is required to rise to at least 85% of rail voltage and drop to 15%.

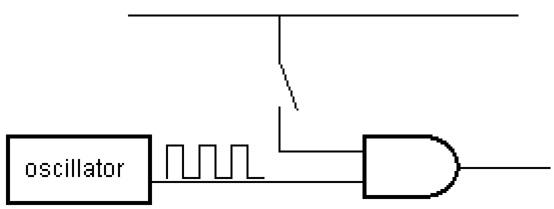
Finally, a point to remember.
Many digital IC's are no longer manufactured, so keep this in mind when designing a new project.
The NAND gate is called the "universal gate" as it can be converted into all the other gates by simply wiring 1, 2, 3 or 4 NANDs together.

HOW DOES A GATE WORK?

On the previous page we saw how the **output** of a gate goes **HIGH** or **LOW** according to the voltage level on the **inputs**. But how is a gate used in a circuit?
To answer this we need to have a circuit that requires a gate. Suppose we have a circuit producing a constant tone. We want the output to be a beep - beep - beep.
To do this we can turn the tone **on** and **off** or send it through a GATE that allows the tone to pass to the output amplifier then SHUTS IT OFF and repeats the action.
For this to work, the amplitude of the tone must be equal to rail voltage. In other words it must be a DIGITAL SIGNAL. In the animation below, the tone entering the gate is CONTROLLED by the action of input A - the GATING LINE. The tone actually passes **through the gate.** This may be hard to visualise but the tone is identical to a switch on input B, taking the line HIGH, then LOW at a very rapid rate.
If we look at the Truth Table for an AND gate, we see that if input A is **LOW**, any signal on line B does not appear on the output. This is shown in the top half of the Truth Table.
When input A is **HIGH**, the output reflects the voltage level on input B. This is shown in the lower Truth Table and is exactly what we want. In the final version of the circuit, the switch will be replaced by a low-frequency oscillator to produce the beep - beep - beep effect.

AND		
A	B	Output
0	0	0
0	1	0

AND		
A	B	Output
1	0	0
1	1	1



The AND gate is "gating" the oscillator

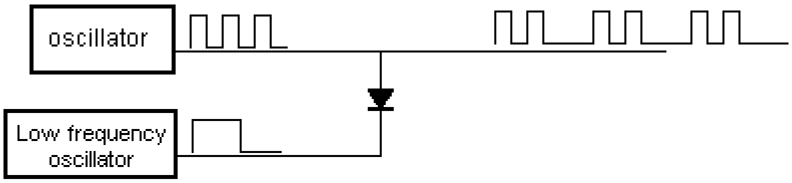
When the signal is prevented from appearing on the output it is said to be INHIBITED.
When the signal appears on the output, the gate is said to be ENABLED.
In the diagram above, you will notice the oscillator and AND gate are not connected to the power rails. This is a **BLOCK DIAGRAM** and power connections are never shown. They are assumed to be connected.

WHAT DOES A GATE DO?

This question has almost been answered above. A gate ENABLES (allows) a signal to pass from one part of a circuit to another. It also prevents (INHIBITS) a signal. The action of allowing and preventing a signal is called GATING.

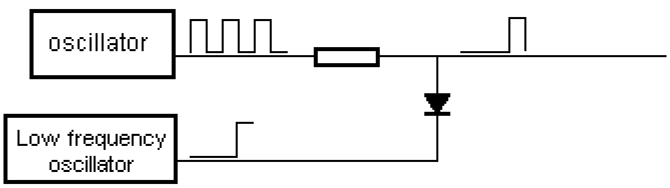
MAKING A GATE

Suppose the amplitude of the waveform from the oscillator above is not sufficient to activate the AND gate - in other words the amplitude is not rail voltage. If this is the case, we cannot use a "GATE" as it will not be activated.
The solution is to turn the waveform ON and OFF with a **GATING LINE.**
A gating line is slightly different to a GATE. A waveform passes through a GATE but a Gating Line "KILLS" the waveform (attenuates it) then "allows it to pass."
The simplest gating line is a diode connected to the output of a low frequency oscillator as show in the diagram below. You will notice the output waveform consists of the oscillator frequency "in bursts." This is the beep - beep - beep sound we require.



The diode is "gating" the oscillator

The operation of the low-frequency oscillator is shown in the animation below: It simply goes HIGH, the LOW to produce the pulses of tone. The resistor on the line prevent damage to the oscillator as the diode "kills" the waveform by acting like a very low resistance and the and the resistor in the circuit is a "safety resistor."
When the output of the low-frequency oscillator goes HIGH, the signal from the oscillator appears on the output.
When the output of the low-frequency oscillator goes LOW, the signal on the output is LOW.

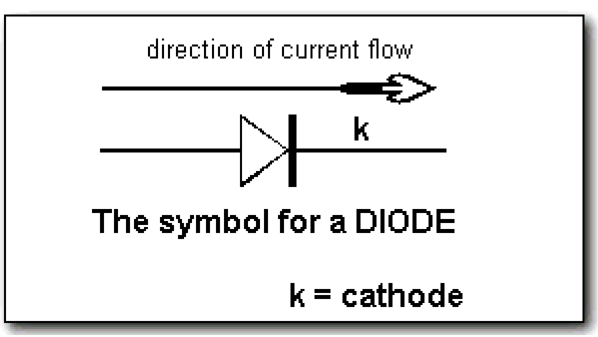


How the diode "gates" the oscillator

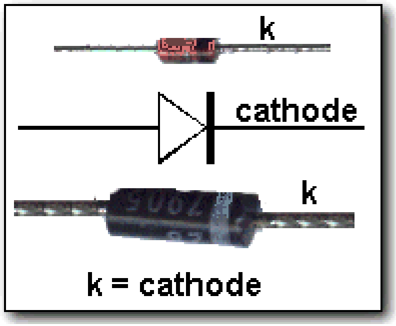
To understand how the diode GATES the oscillator, we have to study the **DIODE.**

THE DIODE
Just like most electronic components, the diode performs a number of "jobs" according to where it is placed in a circuit and the value of the surrounding components.
A diode has a number of characteristics (features that cannot be altered) and the feature used in the **gating line** is the fact that a diode passes electricity in **ONLY ONE DIRECTION.**

A diode is made up of two different materials that have been fused together to create a "junction." This junction passes current in only one direction. If the voltage is applied in the **reverse direction** to the junction, a "barrier layer" or insulating layer develops to block the passage of current. If the voltage is applied in the **forward direction** the barrier layer is very thin and current is allowed to flow.
You can read about the technicalities of how a diode works in any text book but the essential point to understand is the fact that current only flows in one direction and the arrow on the symbol shows the direction.



Diodes come in all shapes and sizes and two of the most popular types are shown below. A signal diode is shown at top and a Power diode below: Basically a signal diode will only pass a small current and a power diode will pass a large current.

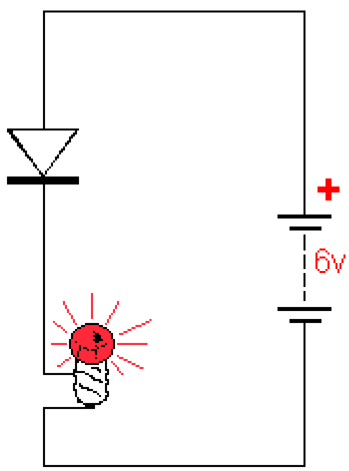


It's fortunate the symbol shows the direction of current flow and the reason is the symbol was created in the early days when current (electricity) was considered to flow from positive to negative.
This convention is still maintained today and is called **CONVENTIONAL CURRENT FLOW**.

When describing our circuits, it is convenient to use conventional current flow as the arrows on the diodes, transistors and LEDs all point in the direction of current flow. (The other convention is called ELECTRON FLOW and electrons flow from negative to positive.)

Normally we talk about the cathode lead of a diode as this is the lead that is identified on the body of the diode. It can be identified by a black ring or band at one end, a dimple or cut-out near the cathode lead or the letter "k."

When the voltage on the **ANODE** is higher than the **CATHODE**, **CURRENT WILL FLOW** through the diode.
If the voltage on the cathode is higher than the anode NO CURRENT WILL FLOW.



How a diode works

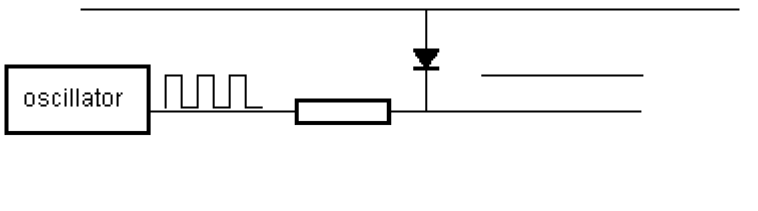
We can now go into more detail and show how the diode in the oscillator circuit above, BLOCKS the signal when the low-frequency oscillator is LOW and allows the signal to pass when the output of the low-frequency oscillator is HIGH.

It is important to "see" what a diode is doing in a circuit. You must be able to VISUALISE it operating.
There are two facts to remember:
1. If the **ANODE** voltage is **HIGHER** than the **CATHODE**, the diode is passing current and the voltage across it is very low. (about 0.6v to 0.7v)
2. If the **CATHODE** voltage is **HIGHER** than the **ANODE**, no current will pass through the diode and it is the same as if it is removed from the circuit.

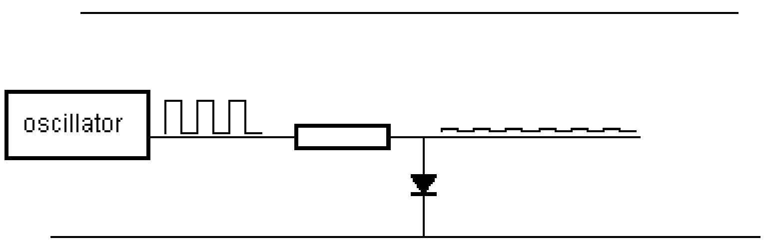
So, you can think of the diode as two things:
In the first case: A length of wire.
In the second case: An open circuit.

Understanding how a diode operates is very important. There are 4 ways a diode can be placed on the output line: The following 4 diagrams show you the effect of the diode.

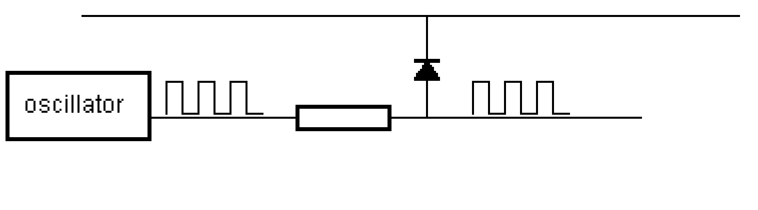
If a diode is placed between positive rail and the signal line, the output is a constant **HIGH**.
This is shown below. The voltage on the anode "turns on" the diode and current flows though it. The voltage on the cathode is 0.7v less than the anode and this makes the signal line a constant HIGH.



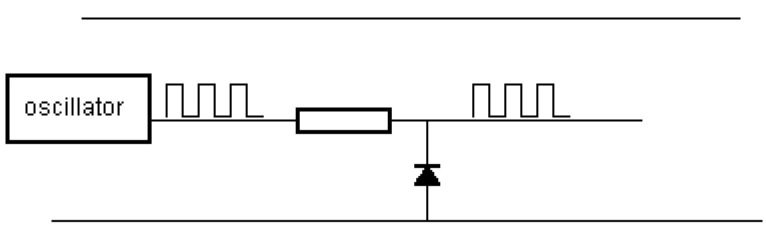
If the diode is placed between the signal line and the 0v rail, the output is a constant **LOW**.
This is shown below. When the signal rises above 0.7v, the diode "turns on" and conducts. Current flows through it and the voltage does not rise above 0.7v.



If the diode is placed as shown below, the anode is never higher than the cathode and so it is never "turned on." The diode has NO EFFECT on the signal and it is the same as if the diode is removed.



If the diode is placed as shown below, it has no effect on the signal. (you can consider the diode is removed from the circuit).

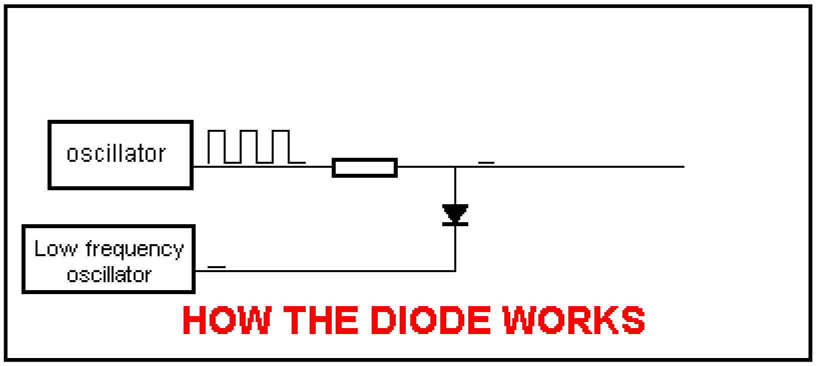


HOW THE DIODE "GATES" THE SIGNAL

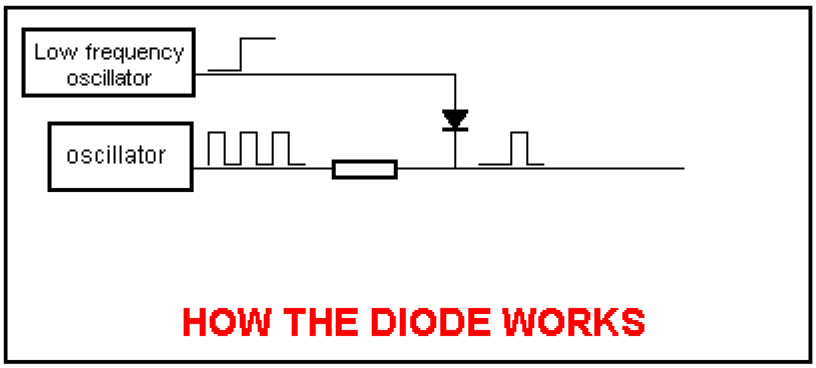
Using the following two facts, we can show how the diode on the output of the low frequency oscillator CONTROLS the signal:
1. When the output of the low frequency oscillator is LOW, the output signal is

LOW.
2. When the output of the low frequency oscillator is HIGH, the high-frequency waveform appears on the output. (the diode is effectively "out of circuit" and it has no effect on the signal).

The amazing animation below shows exactly how the diode is creating the output waveform:

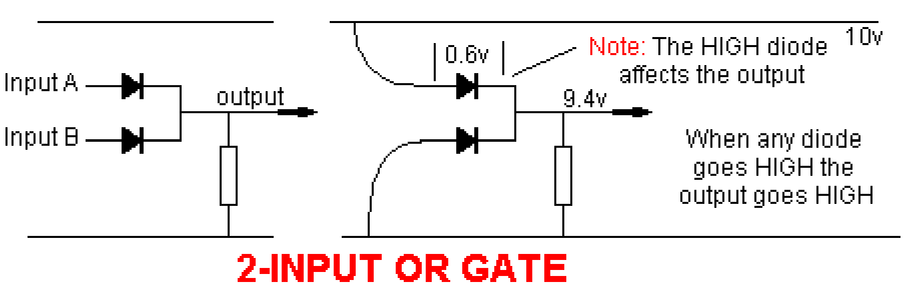


Here is a slowed-down version so you can see exactly what is happening:



THE DIODE **OR** GATE

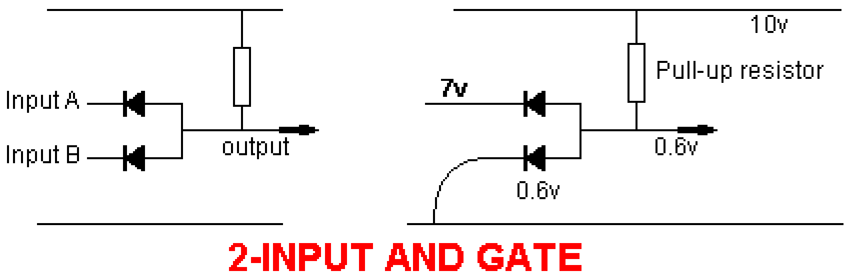
Diodes can also be used to create gates, where the signal passes through the diode.
The diode **OR gate** is a simple example. The voltage and current is passed to the output by the incoming signal and a pull-up resistor is not needed. A pull-down resistor will prevent the output "floating."
The output will go HIGH when line A **OR** line B is HIGH (and also when BOTH inputs are HIGH).
A voltage-drop of 0.6v is lost across the diode but this will not affect the any circuit using this gate.



THE DIODE **AND** GATE

For the diode **AND** gate, BOTH input A **AND** input B must be HIGH for the output to be HIGH.
The diode AND gate works in a slightly different way to the diode OR gate.
The pull-up resistor delivers the output voltage and current (in the diode OR gate,

the input line(s) deliver the voltage and current to the output).
The input lines ALLOW the output voltage to rise when BOTH inputs are HIGH.
The output current of the AND gate is determined by the value of resistor R. When the output is low, this current is termed BLEED CURRENT and flows through the diode(s) to the 0v rail. This current is "waste" current and must be kept to a minimum for good design.



Name the gate that requires both inputs to be HIGH for the output to be HIGH.
Ans: The AND gate.

Name the gate that goes high ONLY when one input is HIGH.
Ans: The XOR gate.

Name the gate that goes HIGH when one input goes HIGH.
Ans: The OR gate.

Can an OR gate be produced with diodes?
Ans: Yes.

What is the voltage drop across a diode?
Ans: 0.6v

When a gate is INHIBITED, does the signal appear on its output?
Ans: No.

When the voltage on the anode of a diode is greater than the cathode, does current flow through the diode?
Ans: Yes.

Current flows from ANODE to CATHODE or CATHODE to ANODE, in a diode?
Ans: Anode to Cathode.

What does the letter "k" on a diode symbol represent?
Ans: The cathode. (Kathode in German)

SPOT THE MISTAKES!

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INDEX

This group of circuits comes from various books and magazines that caught the author's eye due to one or more mistakes in a circuit diagram.
The best way to learn electronics is through mistakes - either yours or others.
No-one is perfect and we all make mistakes, so it's handy to see how mistakes are made and how they get through the proof-reading of a publication.
Some mistakes I have selected are a matter of opinion while others are definitely technical. Maybe I'm too critical, but that's the nature of electronics.
One of the circuits discussed in this article represents a project designed by a "fairly-competent" technical person. It is a key-hole light. He spent months on the design and travelled overseas to complete the project and organise manufacture of both the electronics and hardware. He then had 100,000 units manufactured and shipped to distributors. The unit had the batteries installed because he thought the circuit shut down to zero current. The idea was it could be operated on a display-stand so the customer could see how it worked. Unfortunately the circuit shut down to about 60uA! By the time the units hit the shops, all the batteries were dead! He had a total recall problem. He lost a fortune! All for the sake of 59uA! Who said you couldn't loose a fortune over 1mA?
This is just one instance for the need for perfection - and thorough testing.
Some of the other faults that lead to the demise of "inventors" and "suppliers" include poor quality-control where a component was missing or a wire left unsoldered. A design has to be 100% correct for it to function. So why can't we strive for a perfect layout and presentation of a circuit diagram?
Electronics is a universal language and even a circuit in overseas magazine can be viewed and interpreted correctly, even though the text may be completely indecipherable. Fortunately numerals and symbols are universal and this is just about all you need to work out how a circuit functions.
The purpose of a circuit diagram is to make it easy to understood what the circuit is doing. This means it must be CLEAR and include as much information as possible. All the component values should be included as well as chip numbers and coil winding details.
If it is user-friendly it shows it was produced by a competent technical person.
A circuit diagram is intended for you to be able to either build the device or fault-find an existing problem.
Looking up a parts list to determine the value of a component is both time-consuming and very frustrating. A diagram without any values does not give you any idea of how it works. A circuit of this nature obviously has not been produced by a competent technical person. It is essential to know the value of each component so you can mentally work out what it is doing and how it affects the other parts. How much more convenient to have the values included on a diagram.
That's what POPTRONICS **Interactive Edition** is all about - showing how to draw circuit diagrams correctly and how to "see how they work."
The secret to understanding a complex circuit is to break it into simple sections called **building blocks**. Many of them have (and will be) described in various articles in this e-magazine and this way you will be able to work out how the circuit operates.

We have picked out a set of about 10 examples, here's the first:

THE OSCILLATOR CIRCUIT

The circuit to be discussed is shown in Fig: 1.

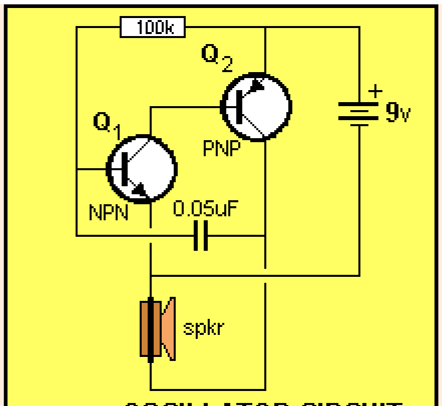


Fig: 1. An **OSCILLATOR CIRCUIT** with mistakes. See text

It is a positive-feedback amplifier but you cannot instantly see this by the way it was presented in a hobby magazine.
The layout doesn't follow any convention and you have to study it carefully to realise the speaker is connected to the output transistor.
The circuit should be much clearer. It should give an instant mental picture of the operation and you should be able to reproduce it by memory, without having to think too hard.
The second mistake is specifying non-standard values. The 0.05uF capacitor should be marked 0.047uf or more appropriately 47n. This value comes under the group called preferred values and our discussion on Page 18 of the **Basic Electronics Course** explains the range of preferred values for capacitors and also lists design values, such as 10n, 22n, 47n, and 100n. These are used in designs if the value is not important. They convey to the reader that the value is a non-critical.
The third mistake is the battery symbol. It shows two cells in series, or 3v. A 9v battery is multi-cell and the correct symbol is shown in fig: 2.
But the most dangerous fault is the connection of the two transistors directly across the supply. If you follow the circuit you will find a current path through two junctions with no current-limiting resistor.
From the positive rail, the current can flow through the base-emitter of the PNP transistor and the collector-emitter of the NPN transistor without limit.
When the circuit is first turned on, the 100k resistor begins to turn on the NPN transistor and this starts to turn on the PNP transistor. Current flows through the speaker. This puts a voltage-drop across it and creates a click. The right hand side of the 0.05u capacitor rises and takes the left side up too.
The capacitor is slightly charged and all this charge goes into the base of the NPN transistor. This turns it on almost fully. A large current flows through the collector-emitter junction of the NPN transistor and this current comes via the base-emitter junction of the PNP transistor. This current will be higher than the allowable amount and may damage the transistor.
The high current will also cause the supply voltage to fall and reduce the voltage to the speaker, so the speaker will not be as loud as in fig: 2. The corrected circuit is shown below. It is much easier to see exactly what is happening.

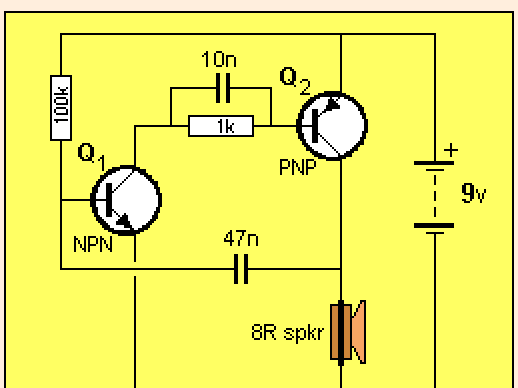


Fig: 2. The corrected **OSCILLATOR CIRCUIT**

The speaker is obviously in the collector of the output transistor and you can see how the 47n capacitor rises when the voltage across the speaker increases.

The 1k between the two transistors acts as a current limiter to prevent the two transistors being damaged.
The 10n allows a high pulse of current to flow in the base-emitter circuit of the PNP transistor, without damaging it and fully turns it on to drive the speaker.
The second circuit will take less current to achieve exactly the same result as in fig: 1, and avoid high currents flowing through the junctions of the transistors.
The second circuit clearly shows the two transistors are a directly coupled high gain amplifier with the speaker as the collector load of the output transistor.
The circuit works on regenerative action (positive feedback).
This is where one section passes a signal to another and it is amplified and returned to the first to make the signal even larger. This happens until the signal is as high as possible (generally almost as large as the supply voltage) and since it cannot get any larger, something happens to reverse the situation, so the signal gets as small as possible and the cycle repeats.
In our case the cycle starts with the 100k on the base of the first transistor charging the 47n capacitor and when the voltage is above 0.65v, the transistor begins to tun on.
This turns on the second transistor and a current flows through the collector-emitter junction and also the speaker.
When a current flows through a load such as a speaker, a voltage is developed across it and this voltage is seen by the right side of the 47n capacitor. The right side of the capacitor rises and takes the left side up with it.
The charge on the capacitor is dumped into the base of the first transistor and this makes it turn on even harder.
This action continues around the circuit until both transistors are fully turned on. This is called positive feedback.
They stay fully tuned on for a short period of time and then the capacitor runs out of charge.
This makes the NPN transistor turn off slightly. This turns off the PNP transistor and the voltage across the speaker reduces and the capacitor drops slightly. This puts less voltage on the base of the NPN transistor and it turns off. This action continues around the circuit until both transistors are fully turned off.
The 100k resistor begins to charge the 47n to start the cycle again.
This action repeats 500 to 5,000 times per second, depending on the value of the capacitor (47n) and 100k resistor. If the capacitor is reduced in value, the frequency is increased. If the resistor is increased in value, the frequency is reduced.

THE FLIP FLOP CIRCUIT

The second circuit we will discuss is shown in fig: 3. It was found in a project booklet for beginners and contains no fewer than seven mistakes. Some you will agree with while others will create a debate.

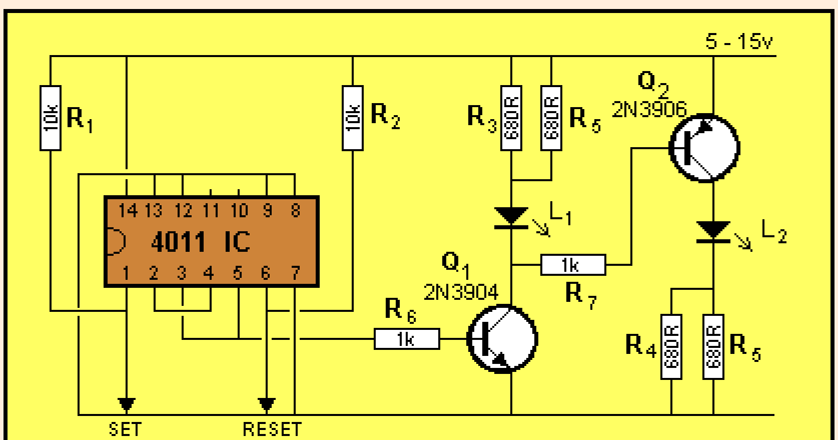


Fig: 3. The **FLIP FLOP** as presented in the project booklet

In any case, see if you can find seven things. You may not agree with everything I have found.
1. The first, and most obvious mistake is the 1k resistors on the base of the transistors. A 1k resistor is a very low value for a small-signal transistor. It will deliver about 15mA to the base and this is too high. The base should see no more than 1mA. In this case the resistor should be 10k to 47k.
2. The 4011 IC is a CMOS device and has high impedance inputs. It should have 100k to 1M for the
pull-up resistors.

3. The supply voltage of 15v is getting very close to the maximum voltage for some CMOS chips.
Some have a maximum of 15v or 18v, or 22v, depending on the manufacturer.
CMOS should be limited to 12v to be on the safe side.
4. The circuit has two 680R resistors in parallel as the load resistors for the Light Emitting Diodes. The supply voltage is in the range 5 - 15v.
With a 15v supply, the current through the LEDs will be nearly 36mA and this is higher than the allowable maximum. LEDs are rated at 20mA for normal operation. The current can be increased to 25-30mA for short periods and up to 40mA in pulse mode.
5. When designing a circuit such as this, it is normal for a switch to give a positive pulse when it is closed. This is called positive logic and is the easiest logic to understand.
The opposite logic is called negative logic in which a negative pulse (or zero pulse) is applied to an input when a switch is closed. The SET and RESET switches in fig: 3 introduce negative logic and this makes the circuit difficult to understand. (In fig: 4 we have given the switches positive logic.)
6. The LEDs are identified as L_1 and L_2. The letter 'L' is reserved for coils and inductors not LEDs. LEDs are diodes and are given the letters LED_1 , LED_2 etc.
The two additional 680R resistors have the same part number R_5. They should be R_5 and R_8. Every component must have its own separate part number. This mistake was carried through to the parts list where it specified 3 x 680R!
7. Now here is the most interesting fault.
The circuit description says both LEDs will come on when pin 3 is HIGH and go off when pin 3 is LOW. But what is the point of having the second transistor to drive the second LED? Both LEDs could be placed in series with each other and this would save 3 or 4 components.
A better arrangement is to have the circuit drive two LEDs independently as shown in fig: 4. For this, the two base resistors of the transistors go to pin 3 of the IC.
The diagram in figure 3 is not really a circuit diagram or schematic. The wiring around the chip may be suitable for the beginner so he can wire up the chip but the block diagram for the chip does not tell you anything about the type of gates inside the chip. You would have to refer to a technical manual to find out the 4011 is a quad NAND gate.
The purpose of a circuit diagram or schematic is to show all the symbols so the reader can instantly work out what is happening.
The layout in figure 3 doesn't help you understand how the circuit works and this form of presentation is to be avoided.
The preferred way of laying out the circuit is shown in fig: 4.

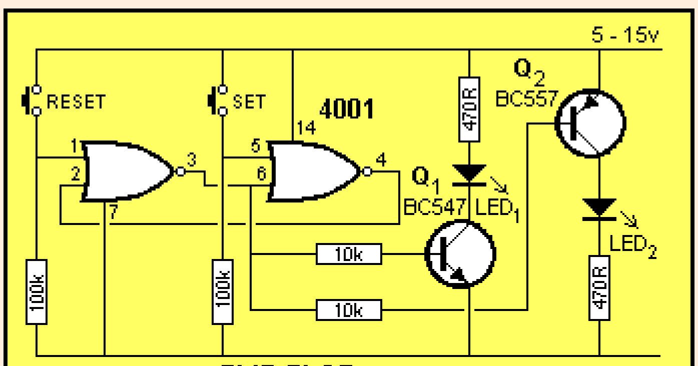


Fig: 4. The improved **FLIP FLOP** circuit

It shows the two gates used to form a **bi-stable flip flop**, while the other two gates are unused. Positive logic has been used for the two switches so that their operation is easy to understand and the resistors have been changed to the correct values. The IC has been changed to a quad NOR gate (4001) so that positive logic can be used.

AN ADJUSTABLE REGULATOR

The third faulty circuit is shown in fig: 5.

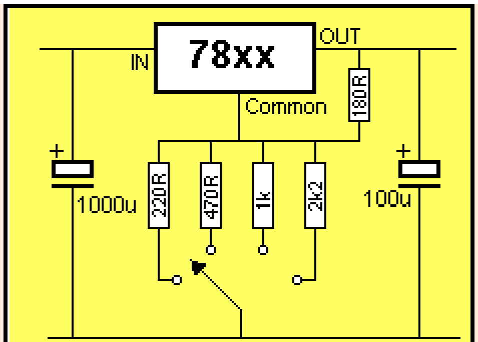


Fig: 5. A switchable **VOLTAGE REGULATOR** circuit

It centres around a Three-Terminal Regulator. These are sometimes called TTR's and all regulators are adjustable to any voltage above their minimum output voltage and up to their maximum safe working voltage, by "jacking-up" the common terminal.
For a 5v regulator the output can be between 5v and 35v. For a 12v regulator it can be 12v to 40v and for a LM 317, it can be 1.2v to 37v. There are other factors that come in to the ability of a regulator to deliver the current at a particular voltage and this is mainly the result of wattage dissipated in the package. This will be covered in other articles.
The Common terminal is sometimes called the adj (adjust) pin and any increase on this pin is passed to the output via the circuitry inside the package.
The electronics inside the package is not simply one or two transistors and a few resistors. It is a complex monitoring circuit requiring 20 or more transistors to maintain a constant output voltage over a wide range of current fluctuations. It also has thermal detection to prevent the package getting too hot and current limiting to prevent overload.
Three terminal regulators are very inexpensive for the operation they perform.
Now back to the problem. The fault with fig: 5 is mainly mechanical.
The rotary switch used to change from one voltage to another is a break-before-make type and this means there will be a very short period of time when no voltage divider resistor is connected to the ground or earth rail.
This means the 180R "pull-up" resistor will pass the full output voltage to the common pin and increase the common terminal by a value equal to the voltage of the regulator. If the regulator is a 7805, the output voltage will increase by 5v to 10v. The 10v will be passed back to the common pin and the output will rise a further 5v. The output will keep rising until it is about 4v less than the input and this could be 25v or higher!
Any voltage-sensitive equipment being supplied by the regulator will get a pulse of very high voltage during switching and may be damaged.
The correct way to add a **selector switch** to a regulator is shown in fig: 6.

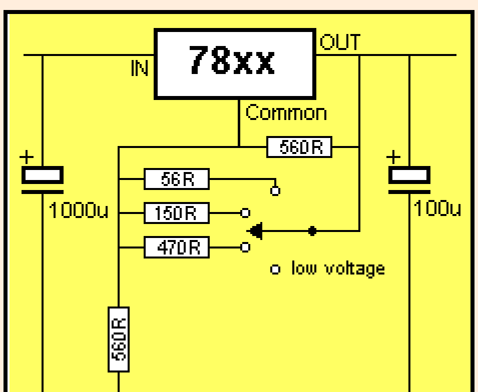


Fig: 6. The corrected circuit for the switchable **VOLTAGE REGULATOR** circuit.

When the switch is changing from one voltage to another, the output voltage DROPS momentarily to the lowest setting. IN the circuit above, the lowest setting is 50% higher than the rating of the regulator. For a 5v regulator, the lowest setting is 7v5.
The "low voltage" setting of the switch does not need any connections as it represents 7v5.
As the other positions are selected, the output voltage is jacked up and when the switch is between positions, the voltage drops to the "lowest value."
The resistance values given in the diagram are only examples and you will have to work out

values for your particular voltages.

5-LED VOLTAGE INDICATOR

The next circuit, shown in fig:7, is a very simple voltage indicator using 5 LEDs to indicate voltages from about 5.5v to 8.5v.

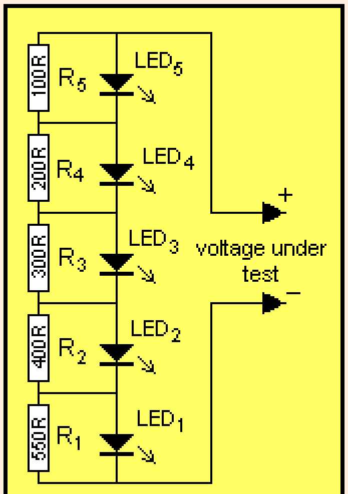


Fig: 7. A 5-LED Voltage Indicator

It's another example of putting a circuit together without actually testing it.
This is one of the things we don't do. We never present a circuit without actually trying it first because things always creep in where you least expect them. This circuit is a typical example.
The author obviously didn't try the circuit because if he had, it would have blown up!
The text says "The two test points are applied to the unknown voltage with the polarity shown."
Can you see what would happen to the circuit if the unknown voltage is 12v?
If not, we will go into a little theory about LEDs, but first let's look at the voltage at which each LED will start to illuminate.
The circuit is perfect in theory - just one resistor has been left off. The parts list did not specify the colour of the LEDs and this is important as each colour has a different characteristic voltage that develops across it and once this voltage is reached, it does not increase.
The other fault is the specification of "oddball" resistors. It doesn't really matter what voltage each LED turns on at, provided the resistors are easy to obtain.
The corrected diagram is shown below but don't refer to it until you have tried to work out what is wrong with the original circuit.
Here's how to work out the turn-on voltage for each LED.
Firstly we will specify red LEDs for the ladder and a red LED turns on when the voltage across it is 1.7v. Some red LEDs need 1.8v - 1.9v so your ladder will need to be calibrated before use.
Let us use 1.7v red LEDs. Suppose we start with a voltage that increases from zero. When the voltage is low, the LEDs exhibit infinite resistance and do not put any load on the circuit.
The only components in the circuit are the chain of resistors.
A voltage will develop across each resistor according to its value and as the voltage rises, the 550 ohm resistor will create the highest voltage across it. This means the 550 ohm resistor is the first resistor we look at.
When the voltage across it is 1.7v, each of the other resistors will have a voltage across them according to its resistance. Resistor R_2 will have 1.23v, R_3 will have 0.93v, R_4 will have 0.62v, R_5 will have 0.3v, making a total of 4.8v.
You can see the only resistor with enough voltage across it to turn on a LED is R_1 and this occurs when the test voltage is 4.8v.
Here comes the next surprise. The voltage across LED_1 does not rise any higher than 1.7v. As more current flows though the circuit, the LED gets brighter but the voltage across it does not increase.
This feature has to be taken into account when working out the rest of the calculations.
As the voltage increases, the voltage across R_2 becomes 1.7v, and LED_2 begins to turn on.
When the voltage across R_2 is 1.7v, the voltage across the total of R_3, R_4 and R_5 is 1.27 + 0.85 + 0.42 = 2.54v
This makes the test voltage = 1.7v + 1.7v + 2.54v = 5.94v.
We really don't have to get into accuracy like this but it has been presented to show you how to

work out the various values.
LED_3 turns on at 6.79v. LED_3 turns on at 7.65v and LED_5 turns on at 8.5v.
Remember what we said about the characteristic voltage of LED. The voltage does not rise above 1.7v.
If you supply the circuit with a voltage above 8.5v, the LEDs are not going to allow the voltage to rise above 8.5v and any voltage above this is simply going to drive more current through them. When the current rises above 40mA, one or more will be permanently damaged.
This has not been taken into account when the circuit was designed and is a bad omission.
The answer is the circuit shown in fig: 8:

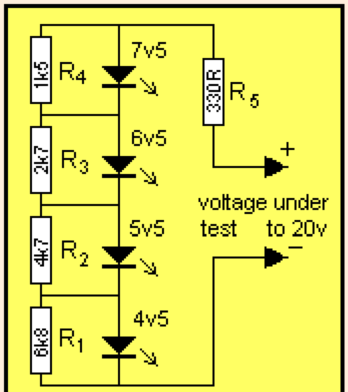


Fig: 8. A 4-LED Voltage Indicator

The solution is to include an extra resistor called the load resistor or current limit resistor and the value will be worked out by limiting the current to 40mA for the stair-case of LEDs and a maximum voltage of 20v.
By Ohms law:

$$I = \frac{E}{R}$$

$$R = \frac{20 - 6.8}{0.04}$$

$$= 330$$

use 330 ohms

Now we have to work out a set of resistances for the ladder so the LEDs come on at about the same voltages as before.
The 330R current limiting resistor sets the parameters for this circuit and has turned it into a very complex design problem.
The whole circuit will have to be designed around very low current because the 330R resistor has set the minimum current.
It works like this:
Firstly we will not be able to have 5 LEDs. Only 4 will operate with the new design.
Secondly we have to assume a LED starts to illuminate when 0.5mA is flowing through it. If you test a LED you will be able to see a faint glow when this current is flowing.
If the LEDs are exactly 1.7v devices, the top LED will turn on at 7v5 and at 9v, it will have about 6mA flowing through it.
For LED_3 to turn on at 6.5v, resistor R4 must be 1k5.
Working out the values for the staircase of resistors is a lot of work and beyond the scope of this article.
A LED is very similar to a zener diode. In fact it is exactly like a zener diode with a window so you can see the current flowing.
A red LED is a 1.7v zener diode. A green LED is about 2.1v zener and orange is about 2.3v.
As soon as the voltage reaches 1.7v or 2.1v or 2.3v, the voltage across the device does not increase. All that happens is the current through the LED increases when you try to put a higher voltage across it.
The increased current flow can be seen by the increase in the brightness of the LED.
In fact you can use a LED as a zener diode and see how a normal zener operates.
You can create any zener voltage by putting LEDs in series as shown in fig: 9.

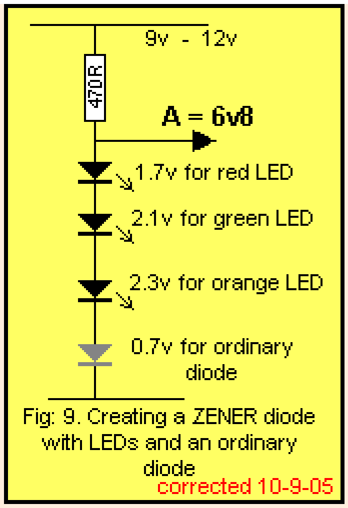
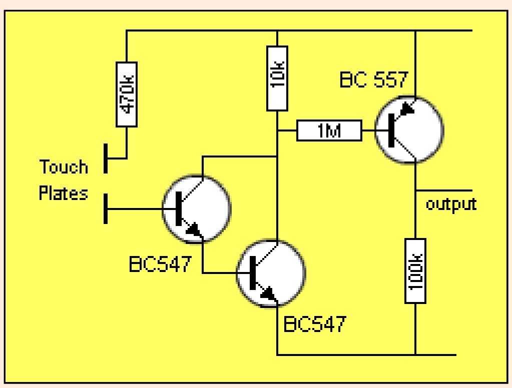


Fig: 9. Creating a ZENER diode with LEDs and an ordinary diode

Don't forget the current limit resistor or you will damage the LEDs, as discussed in fig: 7.
The zener voltage appears between point "A" and the 0v rail. In the example of fig: 9, the voltage will be 1.7 + 2.1 + 2.3 + 0.7 = 6.8v.
Almost any voltage from 0.7v can be created, depending on the combination of LEDs and ordinary signal diodes.

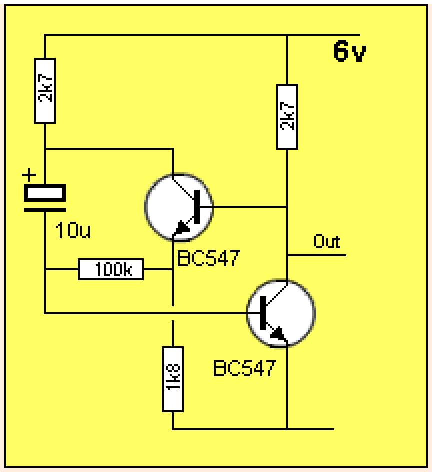
THE TOUCH SWITCH

The following **Touch Switch** circuit misses the point of the high impedance front-end. The 1M on the base of the BC557 is a very high value and will give the transistor very little current capability to make the output of the circuit HIGH.
The super-alpha pair on the front end (made up of the two BC547 transistors) has already created a low impedance output (as shown by the 10k on the output), so the line can be driven low when a finger is placed on the Touch Plates. The 1M could be lowered to 47k to give the output more "driving power" and show that the front-end has produced a low impedance arrangement.



THE OSCILLATOR

Here's an oscillator circuit that doesn't work:



It does not provide a HIGH above 50% of rail voltage and this is insufficient to guarantee clocking of a digital IC. A signal above 70% of rail voltage is needed. In 20 years, the magazine using the circuit in one of its projects did not point out the dangers. It would be a simple matter of viewing the circuit on a CRO to realise the output goes +50% and –20%.
Maybe that's why this circuit has never been repeated in any other magazine.

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SPOT THE MISTAKES!

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THE KEY-HOLE LIGHT

The next circuit (shown in Fig: 10) has two mistakes. One of them was so serious it folded the company! The company marketed the device as a key-hole light to illuminate a key-hole for 6 seconds then turn off. It was a brilliant idea (no pun intended) and they sold thousands of units. But a problem arose. The batteries did not last 2 years as stated on the package. They only lasted 2-3 weeks!
Something must be wrong, they thought. The batteries must be faulty. But after careful testing, the circuit was found to be at fault!
What a disaster. The problem was the circuit did not power down to zero. It took 60uA in the off condition and even though this may not sound very much current, the combination of current and time was sufficient to completely flatten two AAA cells in 3 weeks.
The circuit was obviously designed by someone who knew absolutely nothing about electronics as it had been designed incorrectly.
The original circuit is shown in fig: 10

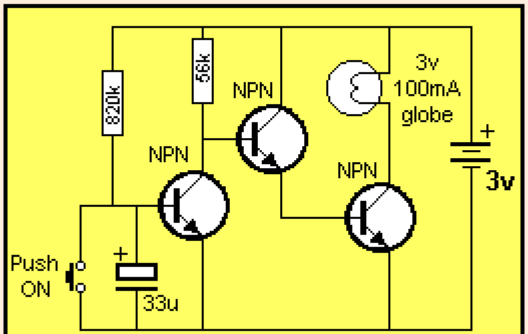


Fig: 10. The Key-hole light circuit

The possible reasoning behind the circuit goes something like this: The first transistor is turned on by the electrolytic charging via the 820k resistor and this holds the other two transistors off. But the current required to keep the electrolytic charged plus that flowing through the 56k load resistor to keep the other two transistors off, is wasted current and when designing a battery operated device like this you have to think very carefully about the "shut-down" current.
By a slight re-arrangement of the parts, and the omission of one transistor, the same 6 second delay can be obtained and the current will drop to less than 1uA when it is not being used. This allows the batteries to last up to 50 times longer and a failed product turns into a success.
Now you can see why it's so important to learn the basics of electronics.
The rise or fall of a company can hinge on knowing a little about circuit design - especially in this case.
Our improved design is shown in fig 11.

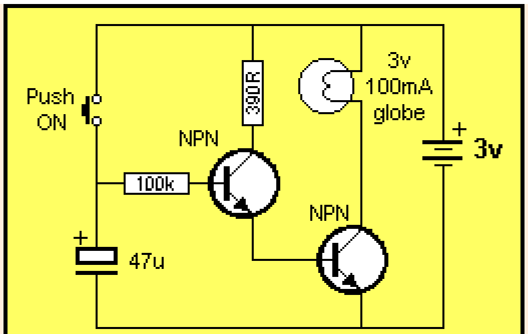


Fig: 11. The improved key-hole light circuit

The 100k resistor serves two purposes. Firstly it limits the current into the base of the first transistor when the switch is closed and it allows the positive side of the electrolytic to charge to full rail voltage.
This gives the electrolytic more energy so the time delay can be as long as possible. The energy from the 47u is then fed into the first transistor via the 100k to keep it turned on for as long as possible.
As the energy flows out of the 47u, the voltage across it decreases and when it drops to about 1.4v, the two transistors (in Darlington mode) cannot be kept on any longer and the lamp begins to dim. Eventually it goes out completely.
To make sure the current in the "off" mode drops to a very low level (about 1uA) it is important that the voltage on the electrolytic is less than 1.4v.
To make sure this happens you could add a 1M bleed resistor across the 47u, but tests on the circuit we built, show the shut-down current falls to below 1uA and this is acceptable for long battery life.
These changes took only a few minutes to re-design and they could save a company thousands of dollars.

THE NIGHT-LITE

Another device that needs slight improvement is the night-lite shown in the diagram below. It turns off when the ambient light in the room reaches a certain level. But the set of night-lites I bought did not go off at all because the light level in the room was not sufficient to turn off the SCR.
The circuit for this is shown in fig 12.

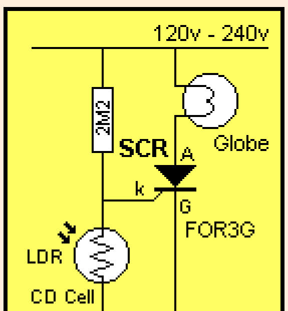


Fig: 12. The nite-Lite

The way the circuit works is the Light Dependent Resistor robs the SCR of gate voltage when the light is bright. This is because the resistance across the LDR (in bright light) is low.
The lamp turns off when the photo resistor (LDR) has a resistance of about 10k. But the light has to be fairly bright to get the cell to go this low and so we had to think of a solution.
There are three possible solutions. Can you think of a way to fix the problem? Solution 1 is to buy another, more expensive night lite.
Solution 2 is to increase the 2M2 to 4M7 so that the voltage divider network made up of the resistor and photocell, will give the gate less voltage at a particular light intensity.
But the simplest answer is to place a 10k resistor across the photo resistor so that it helps rob the gate of turn-on voltage.

A TRANSISTOR CIRCUIT

Next we come to a transistor circuit from a text book. The author states that if the base is shorted to the emitter, the voltages will be as shown in fig 13.

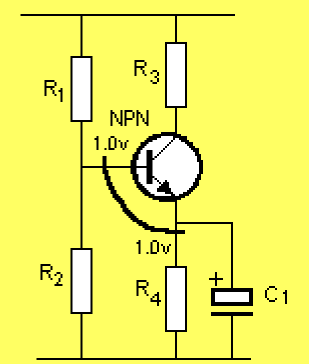


Fig: 13. The transistor circuit under investigation

At first glance you may accept these figures but let's look into the reality of the situation. No values of components were given on the diagram and this is possibly why the writer made the mistake. He obviously did not try the circuit himself - which is a gross oversight.
The resistor values in fig 14 are typical and will produce about 1v on the emitter of the transistor.

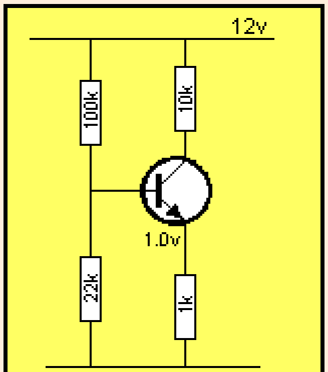


Fig: 14. The transistor circuit under investigation

When the base is shorted to the emitter, the transistor turns off and it effectively comes out of circuit.
The only remaining components are the 100k in series with the emitter resistor and 22k. The voltage across the 1k will be 1/100th of 12v or 0.12v and NOT 1v as stated in the text book.

A WATER DETECTOR

Here's another simple circuit with a basic fault in the design.
Fig: 15 shows a water detector using a sensor plate made from a PC board having two interleaving tracks. The circuit detects water such as the flooding of a basement etc.

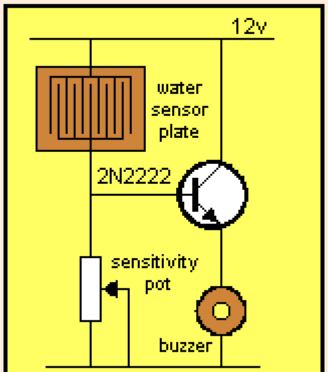


Fig: 15. The **Water Detector** circuit

The basic fault in the circuit is the placement of the buzzer. It is in the emitter of the transistor and this makes the transistor an emitter follower.
The resistance of the detector plate forms a voltage divider with the 1M sensitivity pot and the voltage at the junction of these two is passed to the base.
As the resistance of the detector plate decreases, the voltage at the junction increases and the transistor passes this voltage to the buzzer. When the plate is 1M, for example, the voltage at the junction will be 4.5v. At this voltage the buzzer will not be very loud. The plate must reduce to less than 100k to get the maximum voltage possible for the buzzer.
If the buzzer is placed in the collector, it will be louder for the same degree of moisture detected. In other words the circuit will be more sensitive.
Obviously the circuit needs to be as sensitive as possible so that it can be "turned down" if necessary. Fig: 16 shows the correct circuit.

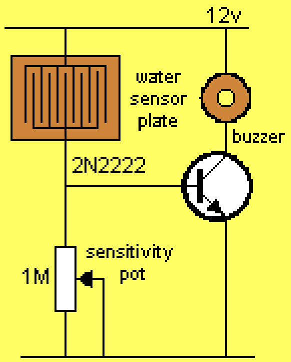


Fig: 16. The improved **WATER DETECTOR** circuit

If the water being detected has a lot of dissolved salts, the resistance across the sensor plate will be very low and you may require a resistor to limit the base current to prevent the transistor being damaged.
One other minor point. A buzzer is not a very loud device and if you require a loud output, you should use a piezo sounder. This is a piezo diaphragm with an active circuit that will produce a very loud output at 9v. It requires very little current (about 15mA) and is ideal for this purpose.

LED FLASHER

Three faults in the next circuit (shown in fig: 17) are fairly technical.

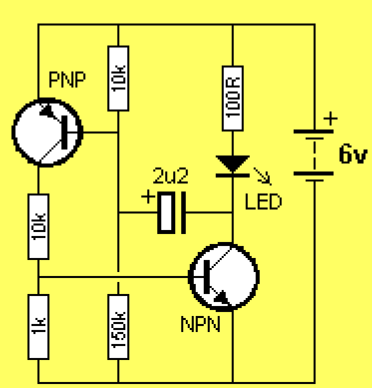


Fig: 17. The faulty **LED FLASHER** circuit

Before we look at the faults, let's talk about the development of circuits that flash one or more Light Emitting Diodes. In the early days a number of circuits were designed to flash a small globe or alternately flash two globes. These circuits were either a multivibrator or a positive feedback amplifier.
With the development of the Light Emitting Diode, the circuits were re-designed.
An example of the multivibrator is the Robot Man project in Learning Electronics Book-1 and an example of the positive feedback circuit is the LED Flasher project, also in Learning Electronics Book-1. Both these circuits are highly reliable. They will operate with almost any types of transistor and any component values near the ones stated on the circuit diagram. They are also

completely independent of supply voltage. Along with these good designs there were a number of others that were very tricky to get going. I recall three early designs and have shown one of them in fig: 17. At a quick glance the circuit appears to work ok but when you build it up, the 150k resistor is very critical and the flash from the LED is very weak. Once you get the circuit going, it will cease to function when the battery voltage falls by even a volt or so. It is simply an unreliable design and that's why it is in the spotlight.
Fortunately, by re-designing the circuit slightly, (as shown in fig: 18), the LED will produce a brilliant flash and the circuit is guaranteed start-up every time. That's the way a circuit should be. It should be completely reliable and guaranteed to work.

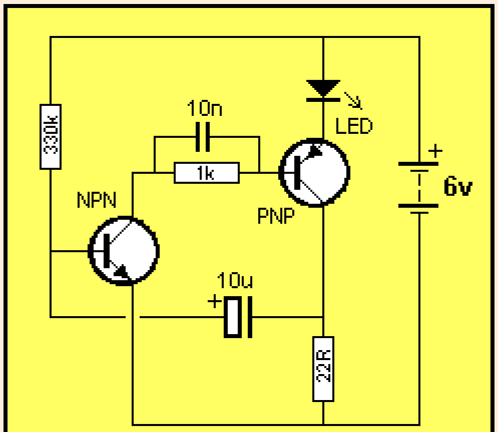


Fig: 18. This **LED FLASHER** circuit works

AN OSCILLATOR CIRCUIT?

Next we come to a circuit that has me fascinated. It's fig: 19.

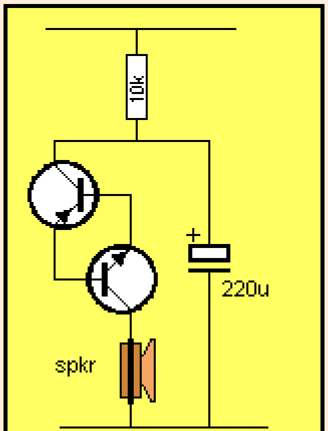


Fig: 19. The **OSCILLATOR** that didn't work

I built it twice, without any luck! It is supposed to produce a siren sound but after putting it together, all I got was a click from the speaker after about 5 seconds.
The circuit charges the capacitor via the 10k resistor. When a certain voltage is reached, the emitter-collector junction of each transistor breaks down and they conduct. This causes the capacitor to discharge into the speaker.
In theory, the capacitor is supposed to discharge to zero volts and unlock the junctions of the transistors so the capacitor can start to charge again. But unfortunately about 0.7v remains across the capacitor and the transistors do not unlock so the cycle halts after one click.
Maybe some types of transistors will work but rather than take the risk, I suggest avoiding anything that requires fiddly attention to get it going.
Most of the circuits in use today are extremely reliable. This is because they have been refined from circuits that did not always have reliability. I classify fig: 19 as unreliable and should be avoided.

A SAWTOOTH WAVEFORM

The next circuit is different. It looks too simple to be an oscillator and you may wonder how it works. The amazing thing is it DOES work. The only problem is interfacing it to other building blocks, as we shall see.
The circuit has a couple of problems that don't come to light until it is put together and tested. That's why we have added it to our list.
The circuit is shown in fig: 20.

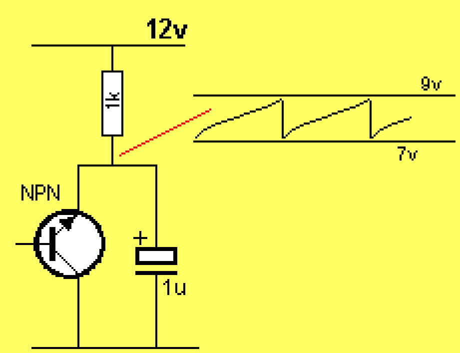


Fig: 20. The **SAW TOOTH OSCILLATOR** and the waveform it produces.

It comes from Charles Rener, of Starlight Electronics. Charles is constantly working with oscillators to drive his electroluminescent displays, so he knows a lot about oscillators. He thought it would be good for this series.
Provided the circuit is supplied with a voltage above 9v, it will produce a sawtooth waveform.
The actual frequency of oscillation depends on the value of the capacitor and resistor in the 'TIMING CIRCUIT.' With 1k and 1u, the frequency is approx 3kHz.
The circuit relies on the fact that a transistor breaks-down or ZENERS when a reverse voltage is applied between the emitter and collector leads.
For a BC 547 this break-down will occur at about 9v. When the voltage drops below 7v, the transistor comes out of break-down.
The capacitor across the transistor is part of a Time-Delay circuit to create an interval of time between 'break-down' and 'non-breakdown.'
The circuit operates as follows: Power is applied and the capacitor charges via the 1k resistor. When the voltage across the capacitor reaches 9v, the transistor breaks down (as it is directly across the capacitor). The transistor effectively puts a short across the capacitor and thus the capacitor discharges through the transistor.
When the voltage across the capacitor falls to about 7v, the transistor comes out of break-down and the capacitor begins to charge to repeat the cycle.
The first fault in the design lies in the fact that the base lead of the transistor is left open or floating and has the tendency to pick up noise and affect the frequency of the oscillator.
But the biggest problem with the circuit is the difficulty to interface it to other building blocks.
The output has a 2v swing but this swing does not come near either of the rails. It is between 7v and 9v. In other words it is very difficult to DC couple the output to another stage.
Finally, the circuit is very wasteful with current. It draws about 4mA at 12v and only produces a 2v swing.

COUPLING

One of the ways to directly couple the oscillator to another stage is to include two red LEDs as shown in fig: 21.

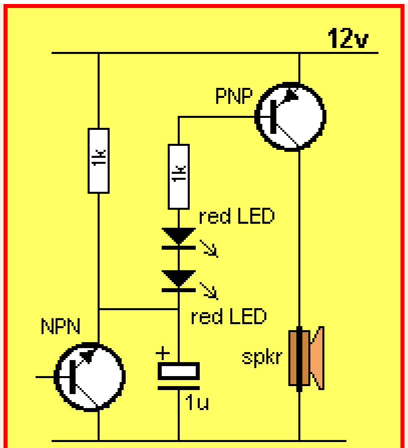


Fig: 21. Interfacing the oscillator to a speaker

We are utilizing the characteristic voltage drop of 1.7v per LED to connect a point on the oscillator to a point on the output stage that has a difference in voltage of about 3.4v.
To see how this difference is arrived at, we refer to Fig: 22.

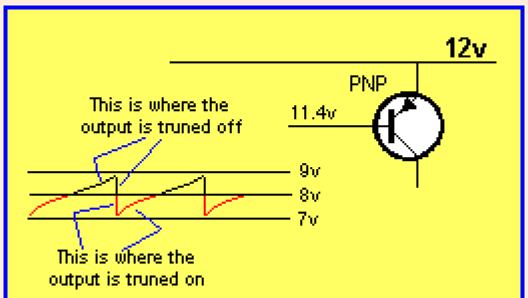


Fig: 22. Matching the voltages

If the output of the saw-tooth oscillator is connected directly to the base of the PNP driver transistor, the transistor will be turned on ALL THE TIME.
To produce a tone in the speaker, the driver transistor must be turned on and off. For this to occur, the waveform must be higher than 11.4v at some point in the cycle.
To create this situation, we add two diodes in the form of LEDs between the output of the oscillator and the base of the driver transistor. Each diode has a 1.7v drop, making a total of 3.4v. This voltage is effectively added to the waveform, creating an output between 10.4v and 12.4v.
It's very important to see how the LEDs are used in this situation. They have not been used as light emitting devices but purely as a voltage drop device. We could equally use a 3.4v zener diode (if one were available) or a series of five signal diodes. The result would be the same.
When the waveform is at 9v, the voltage difference between the output of the oscillator and the emitter of the output transistor is 11.4 - 9 = 2.4v. This is less than the 3.4v required to turn on the two LEDs and thus no current flows through them. This is the same if we use a string of diodes or a zener. No current flows through this type of device until the voltage across it (or them) reaches a potential called the zener voltage.
As the waveform drops to 8v, the voltage at the anode of the top LED is: 8 + 3.4 = 11.4v. and the driver transistor is turned on while the waveform drops to 7v and remains on until the waveform rises above the 8v level. The 1k base resistor separates the voltage on the LEDs from the base voltage.
Overall, this circuit doesn't have any worthwhile applications. However it can be built for its novelty and simplicity.

WHY THE 56R?

There is nothing more embarrassing than designing a project, then being told there is something wrong with the design. This is one such incident.
It's a story about a simple circuit that, on first appearances, is difficult to find the fault - you have to look very close.
The circuit we are talking about is shown in figure 23.

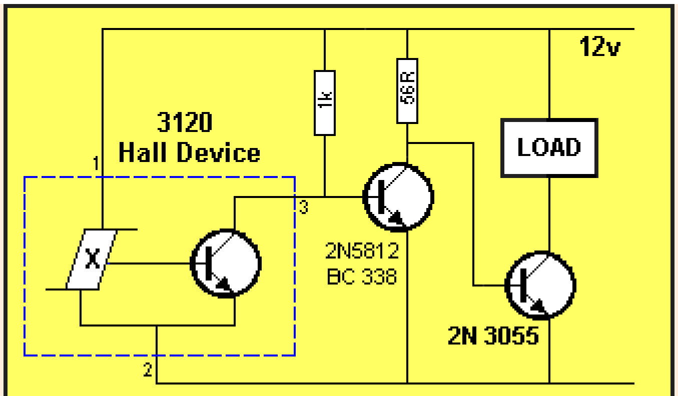


Fig: 23. The circuit under investigation

It consists of a Hall effect device (contained within the dotted rectangle) with leads labelled 1, 2 and 3. Two external transistors connect the hall device to a load.
Firstly a bit of background. A Hall effect device detects the presence of magnetic flux. Some are sensitive enough to measure the earth's magnetic flux and can be used to produce an electronic compass. Others will detect magnetism from a bar magnet or coil etc.
Hall effect devices can range from a simple device to quite a complex item, depending on the number of stages contained within the transistor-looking device. The number of stages determine the sensitivity.
The device used in this circuit is fairly complex, containing an amplifier and Schmitt trigger to give an ON-OFF output, or digital resolution, similar to a switch.
It also contains a buffer transistor capable of handling up to about 25 to 50mA. If a higher current is required, a power amplifier can be added and this is the purpose of the two external transistors.
The middle transistor is an inverting transistor and the third transistor is a power transistor to drive the load.
When the Hall device detects magnetic flux, a special transistor contained inside the Schmitt trigger symbol is turned on (a small amount). This signal is amplified by more stages then passed to the Schmitt trigger stage that "snaps high" when the amplitude is a certain level. This turns the linear activation of the Hall section into an ON-OFF action to drive the buffer transistor inside the package and the output is pin 3.
The 1k resistor between pin 3 and the positive rail turns the output of the Hall device into a digital signal and causes the output to be high (12v) when the buffer transistor is not conducting and low (about 150mV) when the transistor is conducting.
When the Hall effect device is placed in a circuit such as figure 23, the output voltage will not swing as high as 12v as the output is connected to the base of a transistor, we call transistor Q2. The base prevents the output going higher than .65v and we have said the voltage does not go lower than 0.15v when no flux is detected, so these are the two levels you will find when you are measuring the voltages on the circuit.
Going over it again: when the Hall effect device detects a certain level of flux, the Schmitt section causes the internal transistor on pin 3 to conduct and the voltage on pin 3 will drop to about 150mV. This is the collector-emitter saturation voltage of the transistor.
If we now add the two external transistors, the change of state provided by the Hall effect device will be passed to the second and third transistors and finally to the load where a device such as relay or motor will be turned on.
Before we describe the fault with the circuit, we will explain how the second and third transistors work.
The circuit operates in a digital mode and this means the change from one state to the other is quick and the voltage change is a maximum.
The Schmitt symbol inside the Hall device indicates the circuit operates in this mode (fast mode) and when no flux is detected, the buffer transistor is not conducting. This means the 1k resistor is turning ON the second transistor and the voltage between its collector and emitter leads is only about 150mV.
This voltage appears on the base of the output transistor and is below that required to turn the transistor ON and thus the 2N 3055 is NOT TURNED ON.
When flux is detected by the Hall device, the buffer transistor is turned ON and the voltage between its collector and emitter leads drops to about 150mV. This voltage appears on the base of the second transistor and, as we know, it is not sufficient to turn the transistor on.
This is effectively the same as taking the transistor out of circuit so we have only the 2N 3055, with a 56R connected to the base.

This resistor turns the transistor ON and current passes through the collector-emitter leads and also the load.
Now comes the fault in the design.
It revolves around the fact that any circuit should be designed to consume the least power when it is in the non-activated state. The 56R passes about 200mA when the circuit is in the 'ON' state and the same current flows when in the 'OFF' state.
This current is quite considerable and represents about 2.4 watts of wasted energy during the OFF state. If you use a 56R 1/4watt resistor it would burn out! You would need a 3watt wire-wound resistor!
If the circuit was battery operated, even a rechargeable battery would last only a day or so!
This is really wasteful and I don't know how it got past the designer of the project or the editor of the magazine.
By changing the circuit slightly, the current in the OFF state can be reduced to almost zero. This is done by changing the second transistor to PNP and adding the necessary current limiting resistors as shown in fig: 24a.

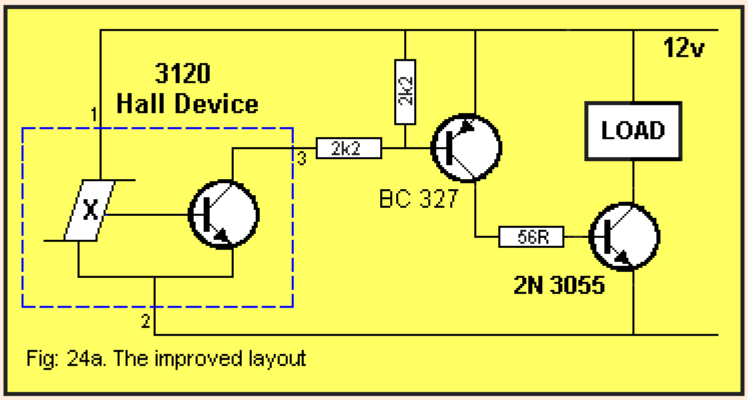


Fig: 24a. The improved layout

The circuit now changes from a poor design to one that cannot be criticised.
When the buffer transistor in the Hall device switches ON, current flows through the 2k2 base resistor to turn on the second transistor. This in turn allows current to flow through the 56R and turns ON the 2N 3055 to supply current to the load.
It's simple improvements like this that make the circuit look 'professional.'
A fault like this would not normally be picked up until the project is built and run for a few hours, or maybe after it has been used by a customer and his battery has gone flat! Only then would you be aware that the circuit is consuming an enormous amount of current in the 'OFF' state.
Sometimes it is very difficult to see faults like this in a circuit diagram.

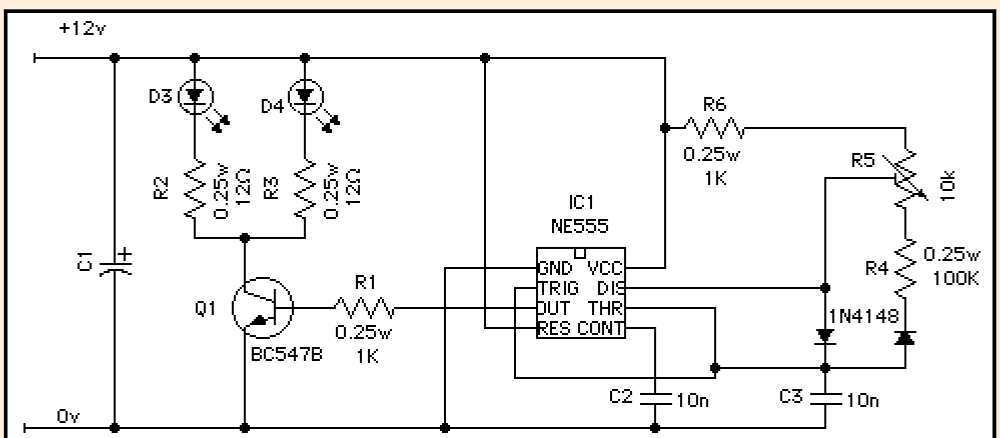
THE 56R

Why did we choose 56R for the second circuit?
The value of this resistor determines the current that can be delivered to the load and if you want to deliver about 8 amps, here is a simple way to work out the value of the turn-on resistor.
The gain of a 2N 3055 is in the range 20 - 70, depending on the quality of the device and the current it is handling.
We will assume the gain is 50 and allow a current flow of 8 amps.
The reason we have chosen 8 amps is due to the use of a 2N 3055 transistor. If the current requirement was only a few amps, a low-power transistor would have been used.
There are two instances when a very high initial current is required. When a motor is first turned on, a very high current flows. It can be as high as 10 times the running current. The current will also be much higher than normal when the motor is loaded. Also, when a globe is first turned on, the initial current is about 6 times the operating current. If this current cannot be supplied, some interesting results are produced, especially if the circuit is a flasher or flip flop. The circuit simply does not work!
For our case, the current to be delivered to the base of the 2N 3055 is 8,000/50 = 160mA. To be on the safe side, we will deliver 200mA.
The voltage across the base resistor will be about 11v and it has to deliver 200mA, so the value of the resistor is determined by ohms law and will be 11/.2 = 55R. We have chosen 56R.
Don't think this is an accurate determination of resistance as we are assuming the gain of the transistor is 50 at a collector-current of 8 amps but it may be as low as 20 or 30.
What happens if the gain of the transistor is as low as 20?
The circuit will still work but the transistor will not turn on fully and the load will not receive full-

rail voltage. This is when the circuit becomes unreliable and that's why you have to allow "a little bit up your sleeve," when selecting component values, to allow for extreme situations and variations in manufacturing tolerances.
Before putting this circuit to rest, you should work out the wattage consumed by the 56R resistor.
A calculation shows the dissipation to be more than 2 watts and so the 56R should be a 2 watt wire wound resistor.
Note that this dissipation only occurs when the globe or motor is activated.
Note: This wattage is called WASTED POWER.
If you do not want to waste energy, I suggest using a MOSFET - but this is a subject for another discussion.

500 MILLIAMPS!

I could not end this article without including this glaring (and dangerous) mistake. LEDs are amazing devices and are capable of emitting light when as little as 1mA is flowing through them.
The brightness increases with current and at 25mA, the LED has reached full brightness and its allowable heat dissipation. Even though we say a LED doesn't get hot, it has a dissipation of 25 x 1.7 = 42 milliwatts for a 25mA current-flow.
If we pulse the LED with a slightly higher current (say 40mA) and deliver a duty-cycle of 25% at a repetition rate of 1kHz, the LED will appear to be fully lit and yet the actual milliwatts being delivered to it is only 40 x 1.7 x 25% = 17mW. This is less than half the consumption for the same effective output.
That's the advantage of strobing or pulsing a LED.
Now we come to the recent article. It stated the current through a LED could be increased to 500 milliamps for a short period of time to get the best efficiency out of a high-brightness LED.
We have already stated the maximum allowable current is 25mA for continued use or 40mA in pulse-mode. Any current higher than 40mA will have the danger of burning out the LED if something goes wrong with the circuit.
Why would you further jeopardise the situation by advancing on this feature and saying a LED can be pulsed with 500mA of current for a very short period of time?
You cannot improve on the efficiency by pulsing with a higher current than 40mA for a shorter duration.
So, let's look at the circuit and see the faults:

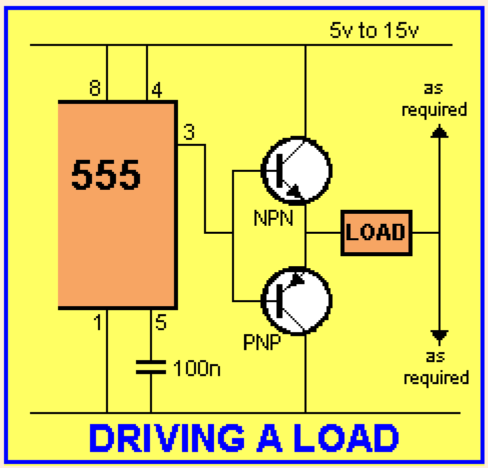


Pulse-width control for high-brightness LEDs

The text accompanying the circuit read as follows:
To give maximum brightness, an LED needs to be driven by a pulse circuit. In this way, it is possible to put 0.5 amp current pulses through an LED at a frequency of around 100Hz which fools the eye into thinking that it sees a continuous light.
If the LED is run at 0.5 amps for very long, it will burn out (usually within a fraction of a second). By keeping the pulse duration relatively short, we can avoid overheating it.
The circuit above allows adjustment of the pulse width so that the maximum average current is no more than 50mA.
To ensure long life, the circuit should be adjusted for maximum brightness then reduced slightly to an average current of around 40mA. One or two LEDs can be driven simultaneously. C1 can be around 1000u and acts as a reservoir because the average battery is unable to supply half amp pulses of current. The circuit can be run from a battery or dc supply of 9 to 12 volts.

There are two major mistakes in the circuit. Apart from the danger of over-driving the LEDs, the circuit is actually incapable of delivering the current suggested in the article. The 12R resistors in series with each LED will allow nearly 800mA to flow when the transistor is turned on.
Fortunately for the designer of the circuit, the maximum current capability for a BC547 is only about 100mA and so the maximum current through each LED will be within the range we stated above.
But if someone changed the transistor for one with a higher current rating, the LEDs would explode!
You can see the danger of presenting a circuit like this. Not only is the text incorrect but the circuit does not behave as stated. This is simply another circuit that has not been thoroughly tested.

I found the next mistake in a 555 Projects book. This is a glaring example of the writer not knowing the in's and out's of the chip. The 555 has a maximum output voltage that is 1.7v LESS than rail voltage. This is a very poor feature and is one of the reasons I do not recommend using this chip for anything other than the simplest 12v project.
Refer to the following diagram for the fault:



The 555 loses 1.7v on the output pin, why fit an emitter-follower to the output and lose another 0.7v? For a 12v supply, the load voltage will be a maximum of 9.6v   The solution is to connect a common-emitter stage and deliver 11.6v to the load.

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modified 26-12-03

SPOT THE MISTAKES!

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INDEX

Power Supply Failure Alarm

Here's a circuit from the web. It has obviously never been tried: Can you spot the mistake?

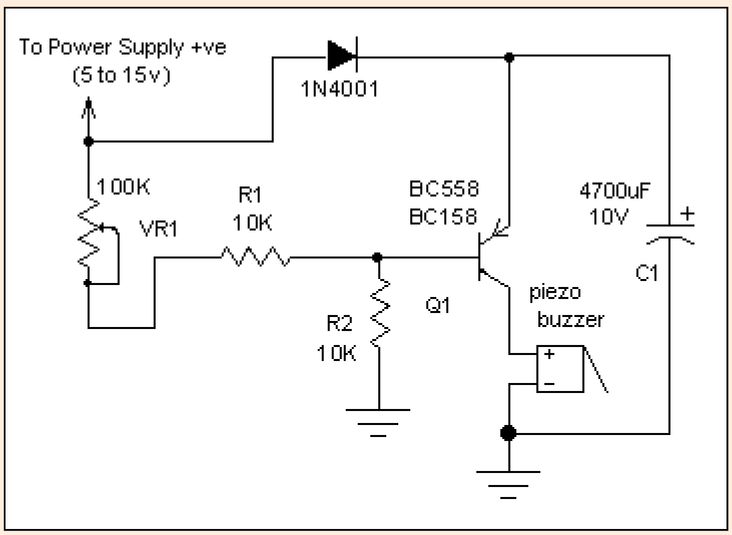


Fig 27. Power Supply Failure Alarm

Here is a description of the circuit as supplied from the website:
Most of the power supply failure indicator circuits need a separate power supply for themselves. But the alarm circuit presented here needs no additional supply source. It employs an electrolytic capacitor to store adequate charge, to feed power to the alarm circuit which sounds an alarm for a reasonable duration when the supply fails.
This circuit can be used as an alarm for power supplies in the range of 5V to 15V.
To calibrate the circuit, first connect the power supply (5v to 15v) then vary the potentiometer VR1 until the buzzer goes OFF.
Whenever the supply fails, resistor R2 pulls the base of transistor low and saturates it, turning the buzzer ON.

The fault in Fig: 27 is R2. It forms a voltage divider with VR1 and R1. The voltage on the base will always keep Q1 turned ON.
Q1 is a PNP transistor. To turn the transistor ON, the base voltage must be 0.7v below the supply rail. The pot (VR1) and R1 form a voltage divider with R2 and to see why this circuit will not work, we need to remove the transistor.
The voltage at the point where the base is connected, will be about 50% of the supply voltage or less, due to R1 and R2 being a voltage divider to produce a 50% voltage. The inclusion of the pot will reduce the voltage further. This will keep the buzzer ON.

By removing R2, the circuit will work perfectly. This is shown in Fig 28:

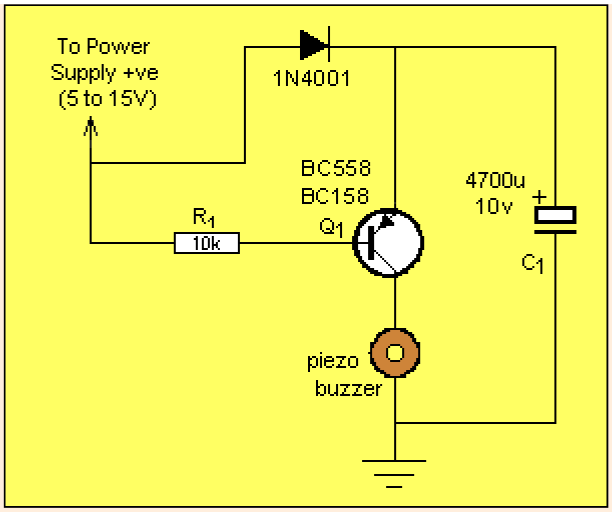


Fig: 28. The corrected Power Supply Failure Alarm

When the supply drops more than 1v, the piezo buzzer will start to come on. The piezo buzzer needs to be an active type (not a piezo diaphragm). It needs to contain an oscillator circuit and produce a loud squeal or beeping sound when a DC voltage is supplied to its terminals.
The purpose of the diode is to prevent the charge on the electrolytic being passed to any other part of the circuit when the power fails.
The electrolytic will be charged to 0.7v less than the power supply, due to the presence of the diode and thus the base voltage must fall 0.7v plus the base-emitter (0.7v) voltage (=1.4v) before the transistor will begin to turn on.
When the power supply fails, the base will be taken to 0v via the 10k resistor and the transistor will be turned on. This is activate the buzzer.

Hearing Aid

This next circuit also comes from the web.
Again, it has never been tested as it has a number of glaring mistakes:

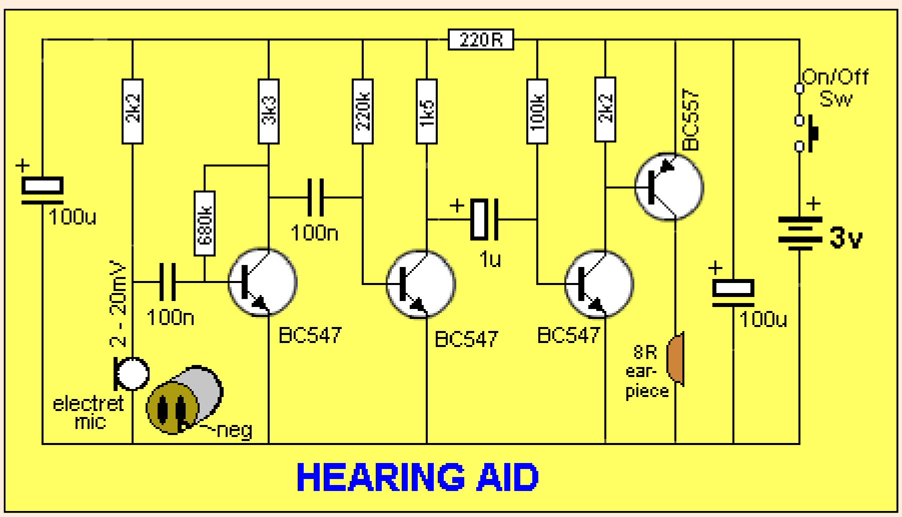


Fig 29: The Heading Aid circuit as presented on the web

The most obvious mistake is the direct connection of the collector of Q3 to the base of Q4.
Q3 is turned on all the time via a 100k resistor and if the transistor has a gain of 100, the collector-emitter will appear as a resistor with a value about one-hundredth of the base resistor - namely 1k.
Q4 will also be turned on and the emitter-base voltage drop will be about 0.7v. This means the 1k resistance of Q3 will appear across the rail and consume 2.3mA. This is wasted current.
Q2 is also turned on all the time and consumes current. By contrast, Q1 is only partly turned on as the collector will be at approx mid-rail.
Since a hearing aid is on for a long period of time, the current consumption should be as low as possible as the batteries must be small and therefore have only a limited amount of energy.

The circuit needs to be re-designed to consume the least current.
The following circuit shows these improvements:

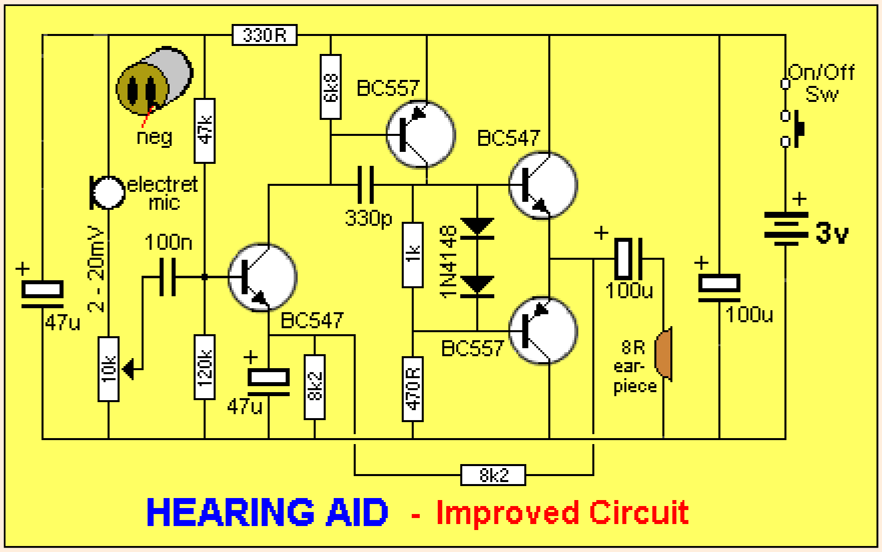


Fig 30: The improve Heading Aid circuit

The output is push-pull and consumes less than 3mA (with no signal) but drives the earpiece to a very loud level when audio is detected.
The whole circuit is DC coupled and this makes it extremely difficult to set up.
Basically you don't know where to start with the biasing. The two most critical components are 8k2 between the emitter of the first transistor and 0v rail and the 470R resistor.
The 8k2 across the 47u sets the emitter voltage on the BC 547 and this turns it on. The collector is directly connected to the base of a BC 557, called the driver transistor. Both these transistors are now turned on and the output of the BC 557 causes current to flow through the 1k and 470R resistors so that the voltage developed across each resistor turns on the two output transistors. The end result is mid-rail voltage on the join of the two emitters.
When setting up the circuit, the first thing you aim for is mid-rail voltage on the emitters.
With a circuit such as this, the most important factor is stability. It is very easy to create unwanted instability called "motor-boating" or "self-oscillation" due to a signal (waveform) on the power rail being detected by the front end and getting amplified to a point where the resulting amplitude completely over-rides the audio you are tying to detect.
The 8k2 feedback resistor provides major negative feedback while the 330p prevents high-frequency oscillations occurring.

Car Interior Light

The next circuit comes from a monthly electronics magazine. It contains two things that need discussing. The first is the need for the 1R resistor. And the second is the difficulty in implementing the circuit.

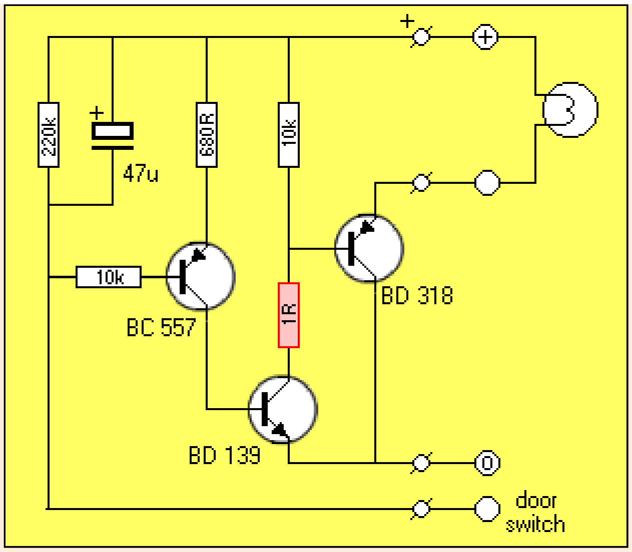
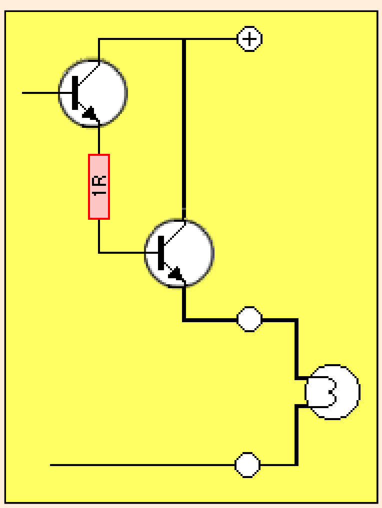


Fig 31: Car Interior light Delay

Let's take the second point:
The circuit is designed to turn off the interior light of a vehicle, about 30 seconds after the door has closed. It is connected to the interior light and some re-wiring of the car has to be done to fit the circuit.
Since two or three doors of the modern car are connected in parallel to the interior light, it is difficult to see how this circuit will work. How is the second and third door connected to the circuit? The article does not explain the difficulty in implementing the circuit.

Now back to our first point. What is the purpose of the 1R resistor?
Q3 is in emitter-follower mode and the base current is always less than the collector-emitter current. It is only normally about 1%, but can be up to 10%.
In other words, only a very small current will flow though the base, so why put a low value resistor on it?
It may be difficult to see what is happening, so we will invert the output and show it as follows:



It is now obvious to see what is happening. The output transistor is in emitter-follower mode and is being pulled up via the driver transistor. The 1R resistor will not have any effect on the circuit.

On the other hand, our design is fitted across one of the door switches and no alteration of the wiring is needed. All doors will provide the interior-light delay and it's a simple procedure to fit our circuit.
Simply pull out one of the door switches and connect the circuit to the wire connected to the switch and an earth wire. The circuit can be made on a long thin board that can be heat-shrunk and pushed through the door-switch hole and the switch replaced. It's as simple as that.

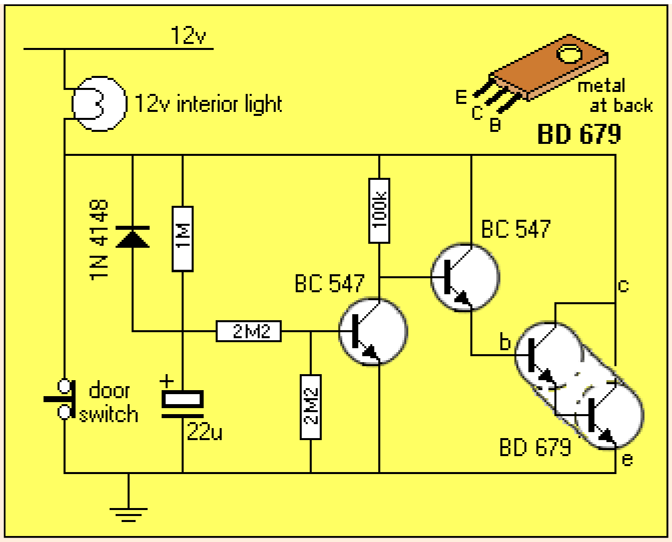


Fig 32: Courtesy Light Extender

PUSH PULL

There are two ways to produce a **Push-Pull** arrangement. These are shown below:

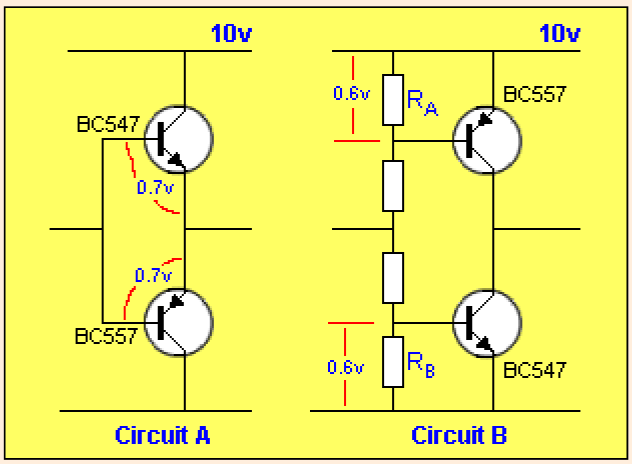


Fig 33: Two push-pull output circuits

First, a little theory behind Push-Pull.
Circuits A and B are called basic arrangements. Note the placements of the PNP and NPN transistors. They are placed differently in each circuit.
The circuits are called **Push-Pull** as the two output transistors are taking it in turns to deliver energy to the load. The transistor arrangement is called Complementary-Symmetry.
To produce speech or music from a low impedance device such as a speaker, the driving circuit must be capable of delivering a high current to get volume from the speaker and the waveform must follow the original signal to prevent distortion.
For the speaker to produce a loud volume, it requires energy (power) and since the supply voltage is low, the current must be high to obtain a driving force called **watts**.
The following animation shows how the input waveform is passed to an output device such as a speaker:

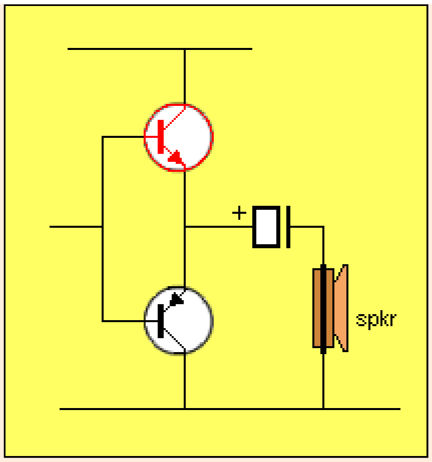


Fig 34: Driving a speaker

The animation isn't entirely accurate but it shows the signal driving one transistor at a time and being passed to the speaker via an electrolytic. The electrolytic is charged and discharged a small amount during the processing of a signal and forms part of the signal entering the speaker during the time when the lower transistor is turned on.

In circuit **A**, the input and output are in-phase. This just happens to be so. It is not an important factor in this discussion. When the input rises, the top transistor is turned ON and pulls the emitter up. If the output is at say 1.7v (as a result of a previous cycle), it will start to be pulled up when the input is 1.7v+ 0.7v = 2.4v
The input can generally rise no higher than 90% of rail voltage (1v below rail voltage in the example above), so the output rises to 8.3v
When the input is 0.7v below the present state of the output (8.3v), the lower transistor is turned ON and pulls the output down to 1.7v
This gives the output a range of 6.6v for a 10 rail. At the moment we are not concerned with the output voltage range or the efficiency of the circuit.
We just need to see how the output follows the input. The animation above shows this.

Circuit **B** operates slightly differently. The first thing to do is create a voltage divider with 4 resistors so the voltage across each base is 0.6v when the input is at mid-rail.
This must be done to keep each transistor turned OFF during quiescent conditions (mid-rail conditions) and prevent them both coming on at the same time during any part of the cycle.
The voltage across Ra and Rb is created by selecting the correct value for each of the 4 resistors. We will not go into the mathematics of this, at the moment.
When the input rises, the lower transistor will come on and the voltage on the output will fall.
The input only has to rise a small amount for the voltage on the base to increase to the point of turning the transistor ON.
As the input rises further, more current will enter the base and the transistor will be turned on fully.
Further increase in the input voltage will have no effect on the output-level. The transistor is already fully turned-on.
When the input voltage falls below mid-rail, the situation applies in reverse and the output voltage rises.
This means the output ranges from 0.5v to 9.5v and the input voltage only needs a swing of about $1.5v_{p-p}$ to achieve this.
The output of circuit B is out-of-phase with the input and and provides a voltage-gain as well as a current-gain.

Now we come to the problem:
The following push-pull circuit was presented in a magazine recently. It has a major fault:

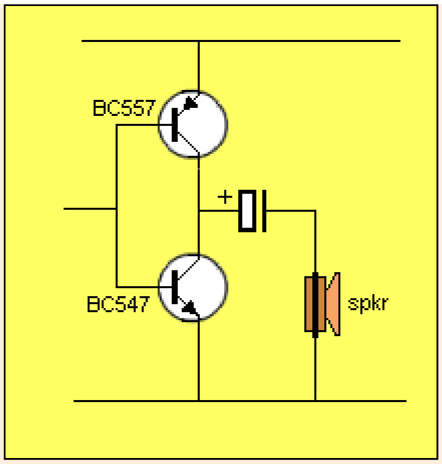


Fig 35: The faulty push-pull circuit

Can you see the fault?
The two transistors are in the wrong positions.
The two bases are joined together and the base-emitter voltage cannot rise above 0.7v.
The two transistors will be instantly damaged.

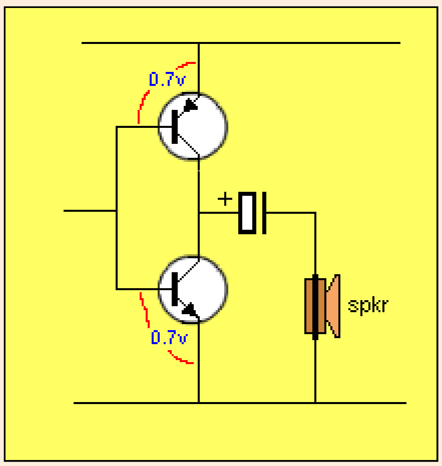
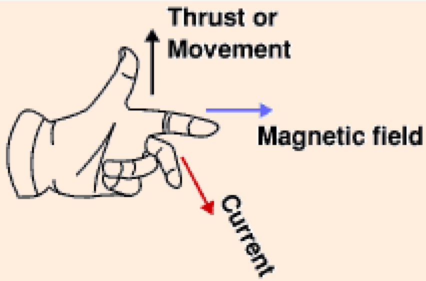


Fig 36: The two transistors will be damaged

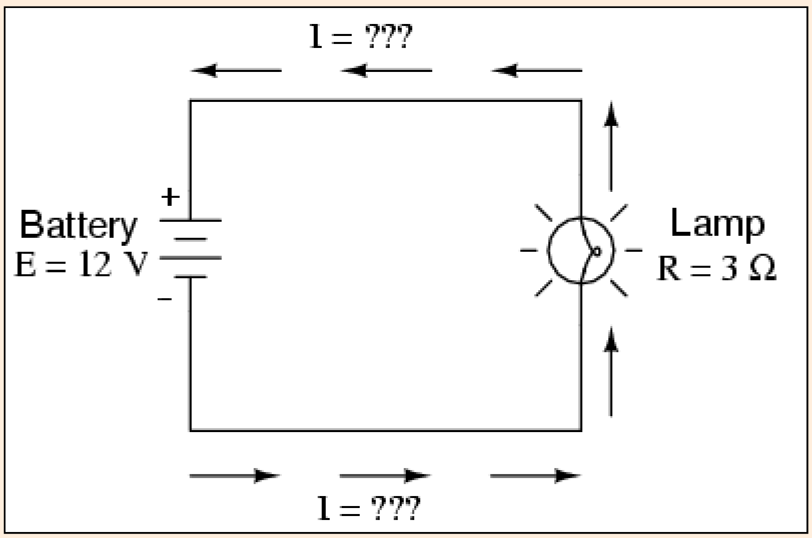
CURRENT

The next circuit has been taken from a "book" on the web.
As far as I am concerned, it contains a number of mistakes.
The author has written a long discussion on the direction he has chosen for "current arrows" and why he has chosen "current flow" from negative to positive.
The facts are these. The argument between **CONVENTIONAL CURRENT FLOW** and **ELECTRON FLOW** has been discussed and concluded many years ago.
It is now accepted that ELECTRICAL circuits show conventional current-flow with current emerging from the positive terminal of the battery.
It is also accepted that any arrow on an electronic circuit represents CONVENTION CURRENT.
When you place a multimeter (switched to current) on a circuit with the positive lead nearest the positive terminal of the battery, the needle reads "up-scale." Why show a circuit diagram with current flowing in one direction and a multimeter showing current flowing the other direction????
There is no point confusing students by being "one-out" and presenting current flowing in the opposite direction. How are you going to apply Flemings Left-Hand rule if you don't know the direction of the current?

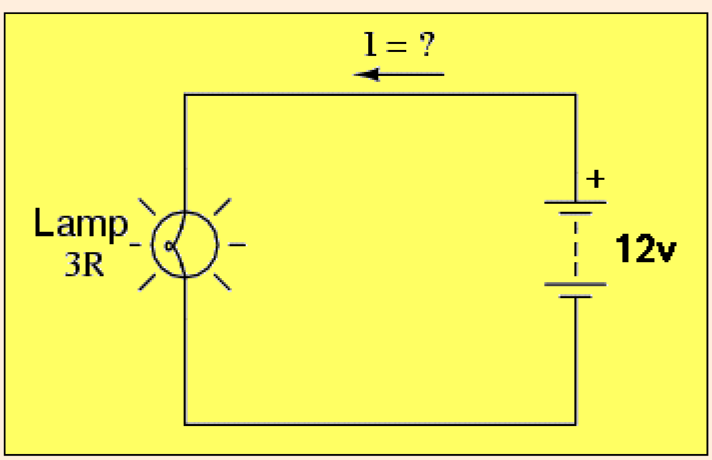


Flemings Left Hand Rule applies to motors

The other notation I do not like is attributing the letter "E" to a normal battery.
The concept of "E" is "Electromotive Force" and applies to a voltage source that has little or no ability to deliver a current.
In addition, the battery symbol is incorrect on the diagram below. It should be as shown in our corrected diagram. If you want to be pedantic, the circuit diagram should also be reversed as the battery or supply is traditionally shown on the right.
The idea of teaching electronics is to present complex items in a way that students comprehend them as quickly as possible. It's not to cause frustration at every turn.



The corrected circuit. Note how simple the diagram becomes. Only one arrow is required for current. Multiple arrows are used when electrons are being identified.



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SPOT
THE MISTAKES!

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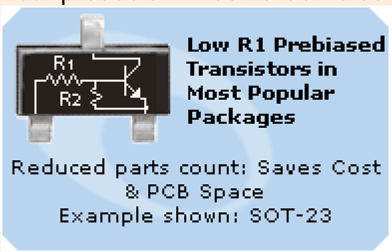
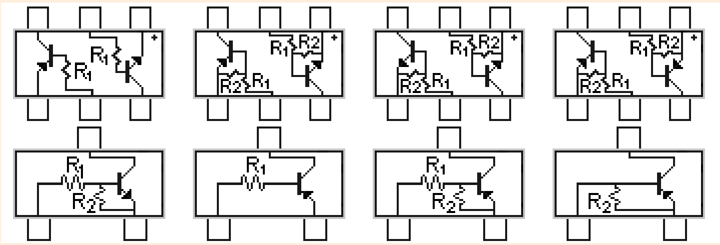
Biasing Resistors

The next discussion is not a mistake but an item that needs careful attention.
A range of surface-mount transistors are appearing on the market with **in-built biasing resistors**.
While this may sound like a good idea, it presents a lot of problems.
Biasing a transistor is a very critical factor and depends on the current to be delivered by the transistor and the quiescent current you want the circuit to take.
The bias-value can range from a few "k" to more than "1M."
You don't want to be "dictated to" by a supplier of components. The range of values offered by the supplier in this case is very limited.
But the major problem with using transistors with built-in bias resistors is the cost.
Surface-mount devices are only available on reels of 3,000 and if the wrong value is chosen or you need to change a particular value, a reel is wasted.
The wonderful part of electronics is its universality.
Electronics is made up of interchangeable components that are common throughout the world and that's why it has flourished and expanded.
We have already made electronics universal, so let's not ruin the concept by individualizing basic components.
When designing a project, make a point of not using specialised components, unless absolutely necessary. It will only back-fire in the long run.
Your products will be harder to service and less-likely to be recommended.



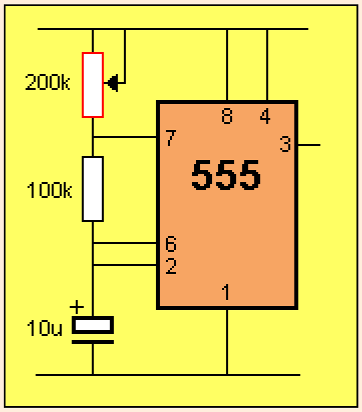
The resistors have values 1k, 10k and 47k:



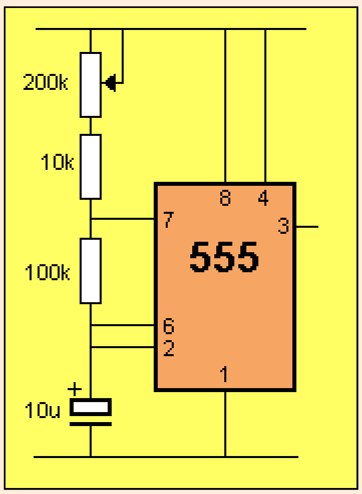
When testing a transistor with in-built resistors, you will get a "false" reading when measuring across the leads of the transistor as the resistor will change the value. This is a feature you need to be aware of.

Stop Resistor

A 555 circuit posted on an "electronics forum" had the following mistake:



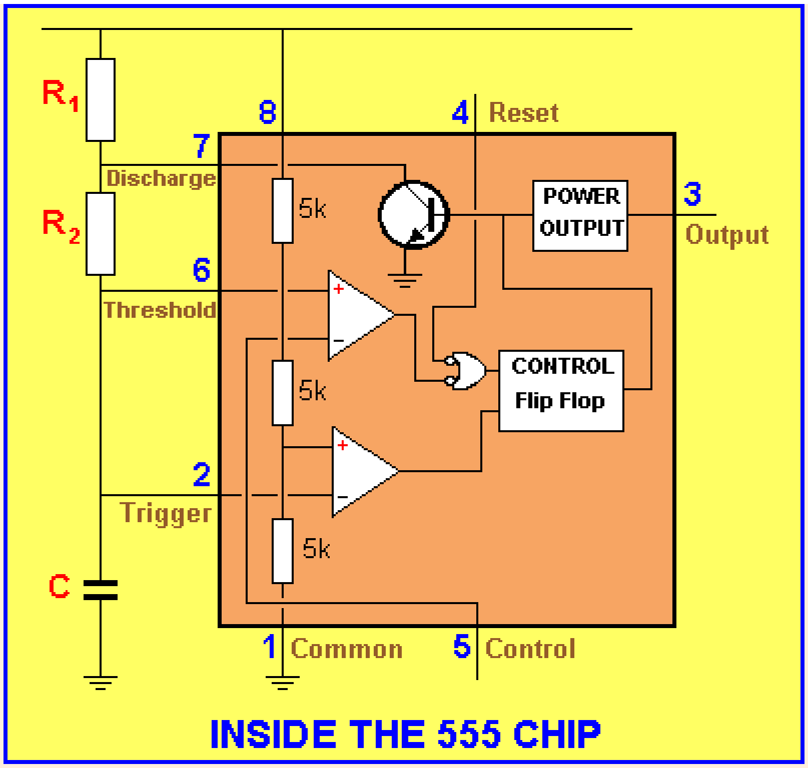
The 200k will damage the discharge transistor inside the chip when it is turned to zero ohms. The circuit needs a "stop resistor" as shown in the diagram below:



Use a "stop resistor"

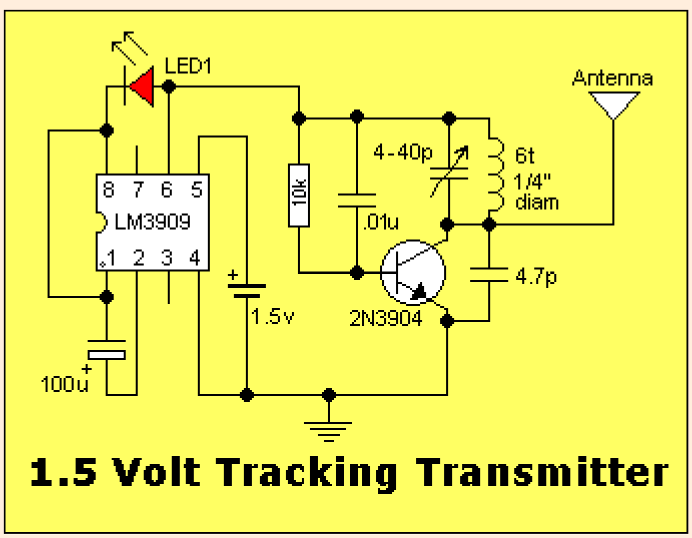
A "**Stop Resistor**" prevents the resistance of a potentiometer going to zero ohms. In some cases a very low resistance will cause a high current to flow and damage either the potentiometer and/or other circuit components. You must always check this when fitting a "pot."

The diagram below shows the internal structure of a 555. Pin 7 is connected to the collector of a transistor and must not be connected directly to the positive rail. If the collector of the transistor is connected to the positive rail, it will conduct a very high current when it is turned on. It is turned on every time the output pin (pin 3) is taken HIGH.
To learn about the 555, see our 3-page article on the CD, P1 P2 P3 or P1 in our Projects section.
On the CD, see the TEST on the 555. On the website the TEST is HERE.
This 555 article is the most comprehensive you will find. It includes a program to show the frequency of oscillation for any value of resistance and capacitance and the HIGH and LOW times.

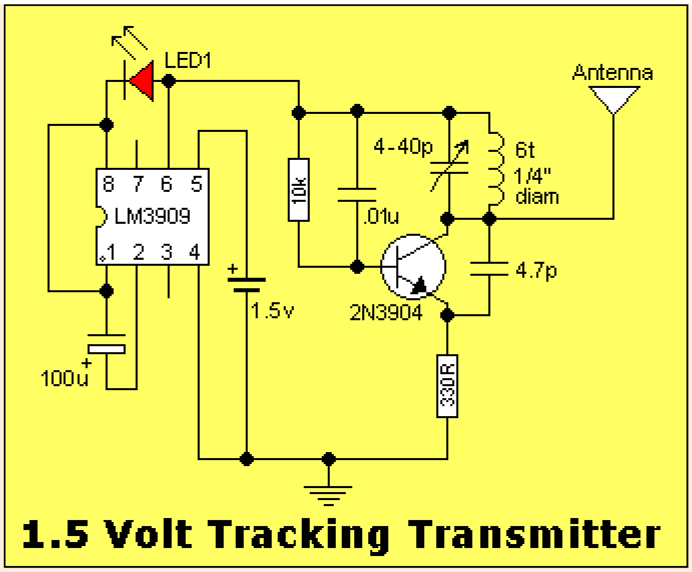


Tracking Transmitter

The next discussion comes from the web.
The circuit is very well designed but a small improvement can be made.



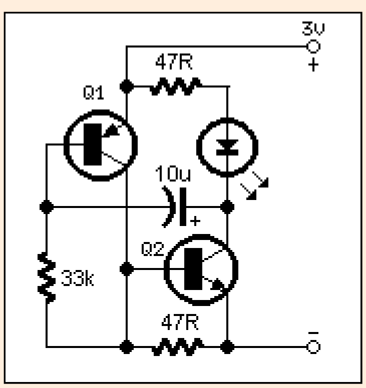
The emitter of the transistor should have a resistor so that the signal through the 4p7 will modify the voltage on the emitter and make the transistor oscillate.



If the resistor is omitted, the circuit may work due to the fact that the LM3909 flasher chip has a high impedance on its pins but the output will certainly be reduced.
The way the transistor gets its feedback to maintain oscillation, is as follows:
The PARALLEL TUNED CIRCUIT, made up of the variable 40p trimmer and coil creates a waveform and this is passed through the 4p7 to the emitter of the transistor. The base is held rigid by the 10n capacitor and the emitter "moves up and down."
There are two ways to turn a transistor on.
One is to raise the voltage on the base, while keeping the emitter fixed and the other is to change the voltage-level on the emitter, while keeping the base fixed.
The 330R keeps the emitter away from "ground" so it can be injected with a signal (voltage) by the 4p7.
The LM 3909 is no longer manufactured and a substitute circuit is shown in our Flasher Circuits article.

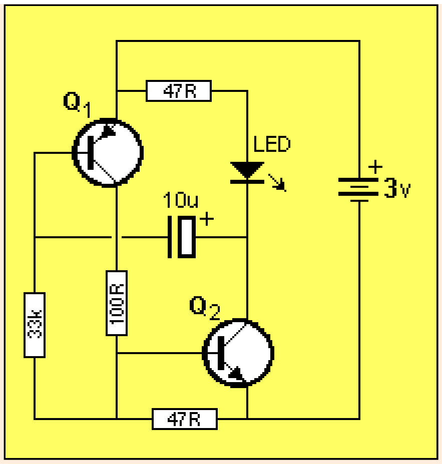
LED FLASHERS

The next mistake is similar to one of the first items we discussed in this chapter.
It's the mistake of allowing the junctions of transistors to be connected directly across the power supply. The following circuit contains the fault:



The faulty circuit

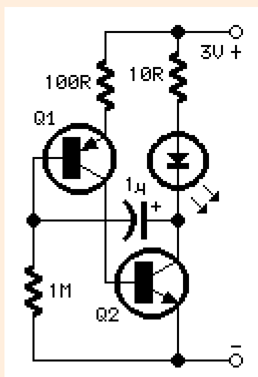
The collector-emitter junction of the PNP transistor and base-emitter junction of the NPN transistor are connected directly across the power supply.
When both transistors are turned ON (when the LED is illuminated) they form a voltage drop that can be as low as 0.2v for the collector-emitter junction and 0.7v for the base-emitter junction. This is lower than the 3v supply and will cause a very high current to flow.
The end result is about 80% of the current taken by the circuit flows though the junctions and only 20% through the LED! This circuit is very wasteful.
By adding a 100R resistor as shown below, the current drops to 10% of the original!
This is only a "proving-point." It does not alter the fact that the circuit is of poor design.



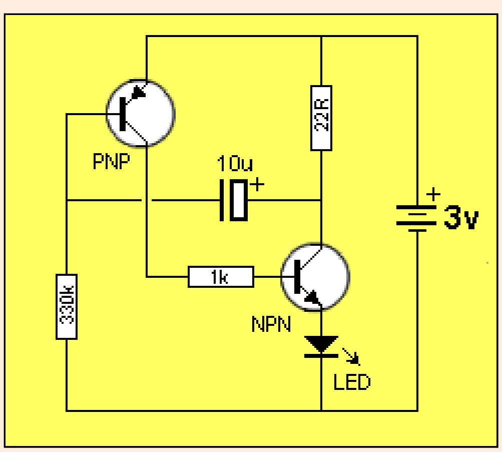
The improved circuit

Both circuits have a number of defects:
1. They will not operate on weak batteries.
2. The bottom 47R represents a low value of resistance and indicates waste of energy. (The top 47R is needed as a current-limiting device for the LED and cannot be changed or omitted.)
The circuit should be re-designed and the bottom 47R replaced with a higher value.

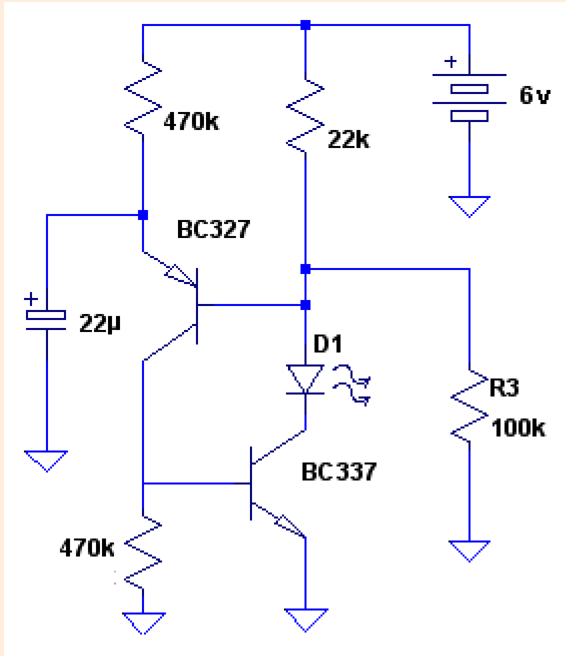
Here is the reply from the author of the original circuit:



The revised circuit has one mistake. It does not work!
The author says it works. But it did not work for me.
Who's right? Obviously I am.
A circuit must work and must be reliable for almost any type of similar transistor. It must also be reliable for component values slightly different to those specified.
That's the art of making a reliable circuit. It must work under a wide range of conditions.
Obviously this circuit is too fiddly.
The answer is to re-arrange the components:



Here is another LED FLASHER circuit:



This circuit has a problem. It does not work when the voltage drops a small amount and will not work on 9v. It is very voltage-critical.
The flash-rate is very low @ 9sec per flash for 22u and 4 seconds per flash for 10u.
However it has one advantage. The current consumption is very low at 50 microamps.
The energy from the electrolytic is delivered to the LED to create a fairly bright flash and there are no losses in a load resistor for the LED.
The 100k and 22k resistors form a voltage-divider to set the point at which the circuit turns on.
The 22u must charge to a point that is 0.6v higher than the mid point of the voltage divider and this creates the timing for the flash as well as the brightness.
If you have a reliable supply voltage, this circuit is suitable. If you are trying to use the last of a 6v set of cells, this circuit will stop when the voltage reaches about 5v.

See our Flasher Circuits article for more circuits.

The next discussion is not a mistake but "how to go about it."

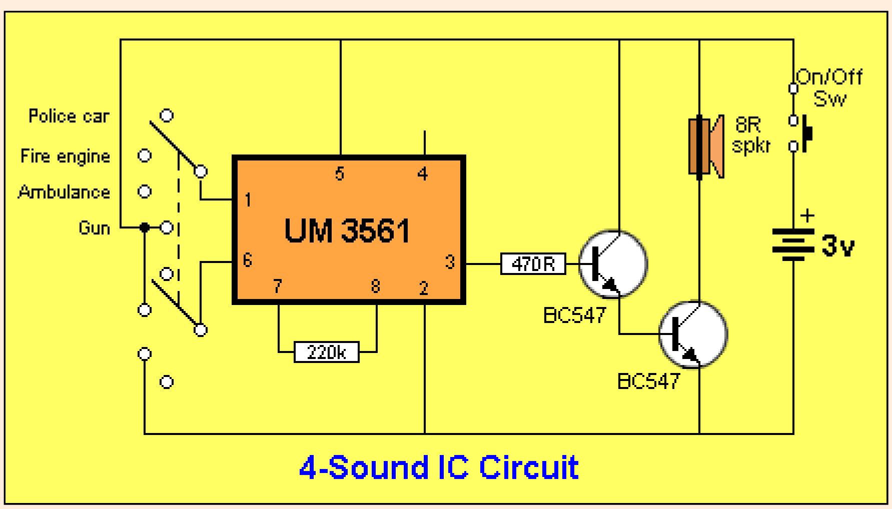
A readers sent a request to identify a surface-mount component:

It is a 6-leaded surface-mount chip 1.13mm X .71mm with "D2" identification.
The letter "D" does not mean it is a diode and the 6 leads do not mean all the pins are used.
After searching through surface-mount identification lists, the reader was no further advanced.

He spent more than 8 hours trying to find a answer.
At this point things become desperate.
You need to advance, so here's my suggestion:
The next step is try and work out if the product is very new or not. This may mean the chip is a "new style" device containing transistors, resistors and diodes in a mini-circuit arrangement.
Next, you have to work out if it is faulty and if you want to risk removing it from the board.
Before you remove it, take a resistance reading across each of the pins in both directions. This will be a lot of readings so make a number of drawings and fill in the details.
To remove the chip you will need a surface-mount removal tool or a fine soldering iron, some fine solder, long-nose pliers and de-solder wick.
Start by soldering each pin with fresh solder. Only solder one pin at a time and wait for the chip to cool down.
This cleans up the joints and makes removal of the solder very quick and easy in the next step.
Use a hot iron and suck up the solder from one pin at a time with a new section of de-solder wick.
Continue with the other pins.
You will now need to put a very fine jewelers screwdriver under the end of the chip and exert a small amount of lifting pressure while running the hot soldering iron down one side of the chip.
One side of the chip will then lift off the board. Grip the chip with fine pliers and run the soldering iron down the other side.
Measuring the chip with a multimeter will not tell you anything. You do now know what's inside it. But measuring it will help in the next step.
Trace out the circuit surrounding the chip.
Sometimes the external components will help you work out what's inside.
You can then solder components onto the lands and create the circuit as a "bird's nest" to see if it works.
This may be a lot of work, but you have to do something.
If you go to our Chip Data eBook, you will find outline diagrams for many of the chips as well as the new "hybrid" chips and links to the web.
From this you will get some idea of what to expect inside the chip.
It's just a matter of duplicating this and see if the circuit works.

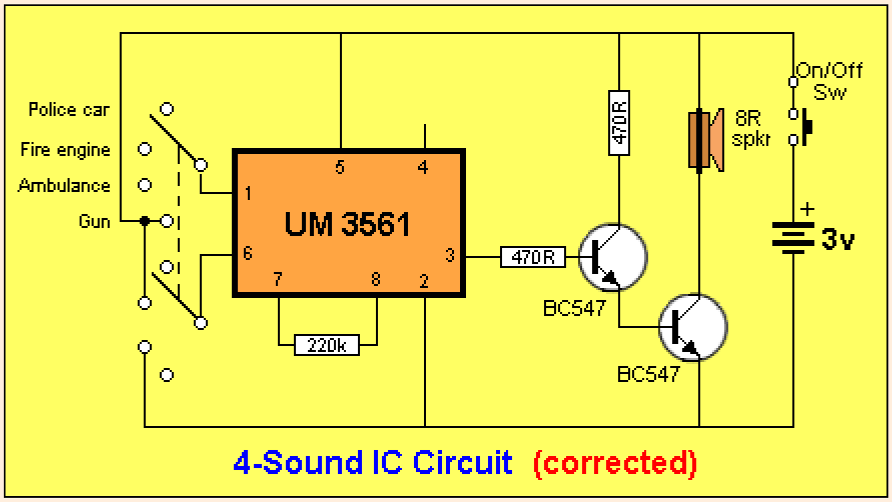
UM 3561 4-Sound IC

Now we have a mistake that has been covered before. See if you can find the problem:



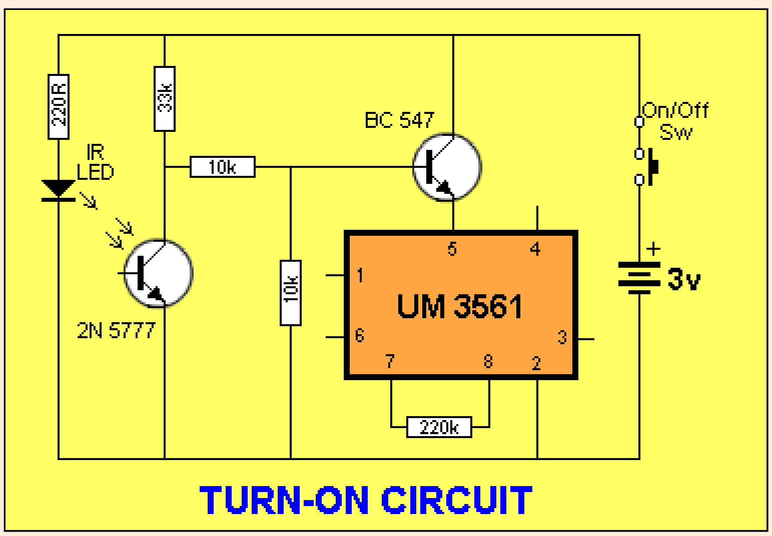
The problem lies in the connection of the first transistor to the positive rail. As the voltage on pin 3 rises, the two transistors begin to turn on when the voltage on the base of the first transistor is 1.3v.
This voltage will not increase but as the voltage on pin 3 increases, the current through the 470R resistor will increase and the first transistor will allow at least 100 times this current to flow between the collector-emitter terminals and into the base of the second transistor.
Using Ohms Law, this comes to 3mA through the 470R resistor and up to 300mA into the base of the second transistor. This is clearly a waste of current and may damage the transistor.

The solution is to add a current-limiting resistor in the collector of the first transistor as shown in the diagram below:

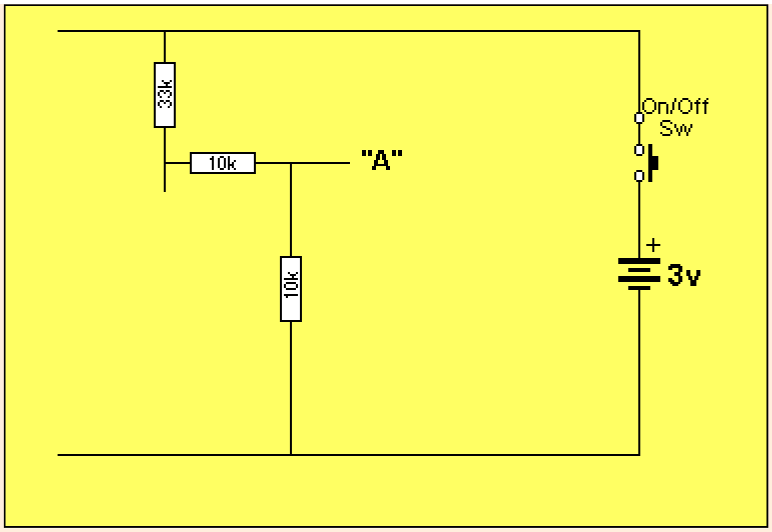


TURN-ON CIRCUIT

The next fault comes from the same circuit we covered above. It is the turn-on section.
When the light-beam is broken, the infra-red receiver transistor has a high resistance and the turn-on transistor is pulled high via the 33k and top 10k resistors.
But there is a fault in the turn-on section. Can you spot it?

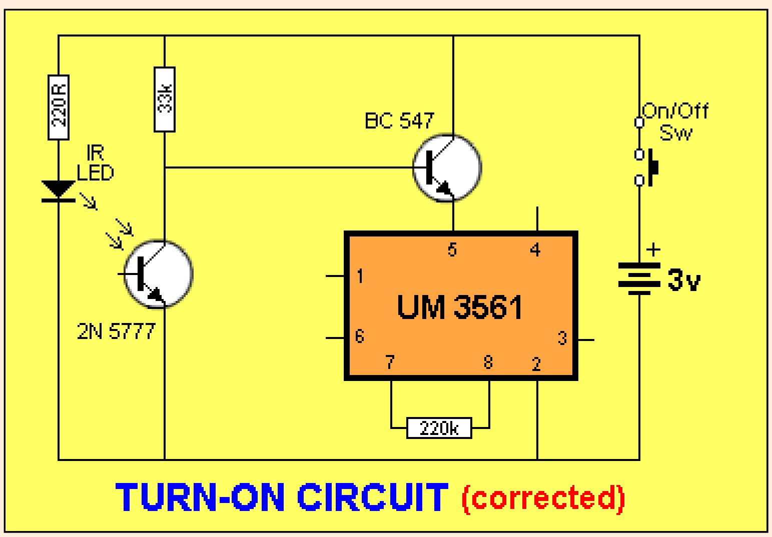


The chip will not see a "turn-on" voltage. The voltage-divider, made up of the 33k, 10k and bottom 10k resistors will put a voltage of 0.56v on the base of the BC 547 transistor. The voltage drop of 0.6v between the base and emitter will result in zero volts reaching the chip.
The lower 10k is causing the problem. It is not needed.
How do you work out the voltage that will appear on the base of the BC 547?
We firstly assume the two transistors are not putting any load on the circuit. In other words, they are high-impedance (not turned on) for this part of the discussion.
The circuit becomes as shown in the next diagram:

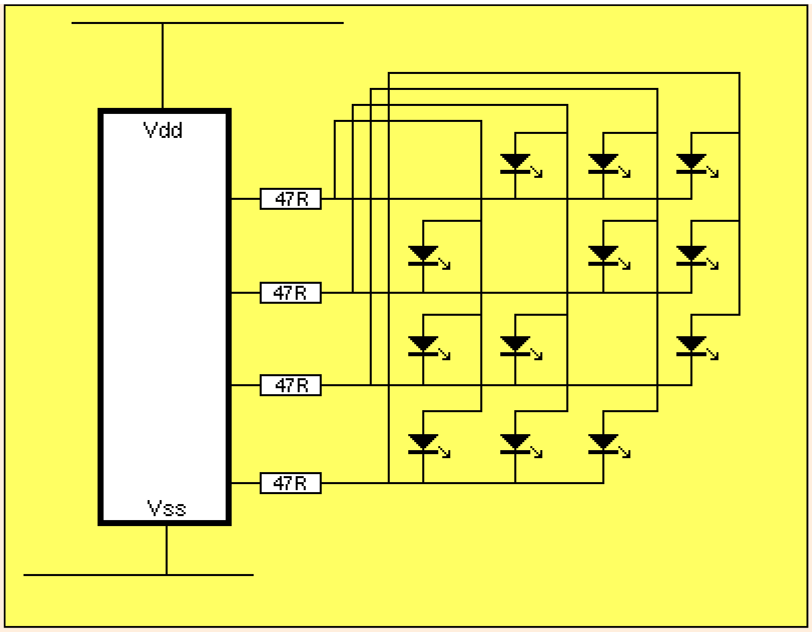


The total resistance of the network is: 33k + 10k + 10k = 53k
The voltage across the network is 3v.
The voltage across each 1k = 3/53 = 0.0566v
The voltage across the lower 10k = 0.566v
As we have mentioned above, the base-emitter voltage of the BC 547 will remove this voltage and the chip will see 0v.

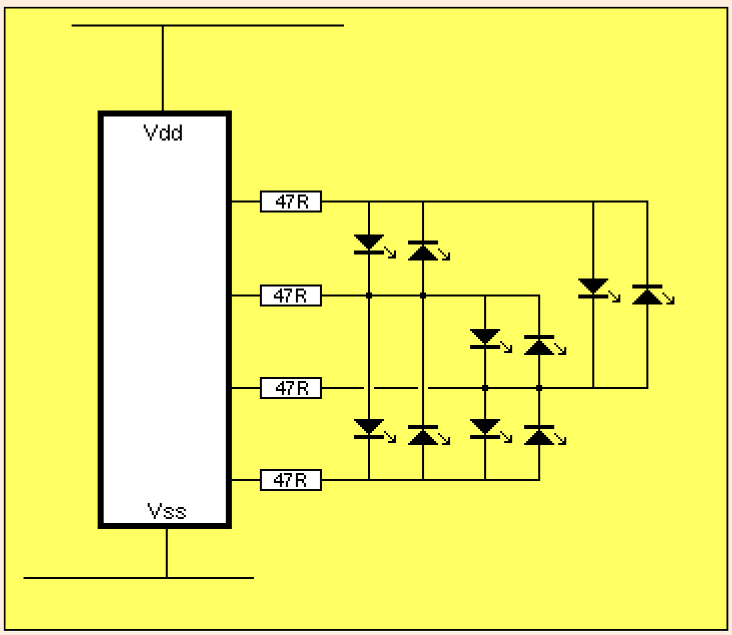
The next point to note is purpose of the upper 10k.
It serves no purpose at all.
The corrected circuit is shown below:



The next item is not exactly a mistake, but an improvement to a layout.
Circuit diagrams should always be laid out so they give an immediate indication of how the circuit works.
The following circuit looks very neat but it is more complex than it should be.
The LEDs are actually connected in opposite directions to the 4 drive-lines of a micro, but this is not obvious.



Here is the improved circuit diagram:



In the diagram above, it is obvious that the LEDs are in pairs, with one LED connected in the opposite direction to the other.
Each pair of LEDs is connected to two output lines so that by reversing the polarity of the lines, any LED can be individually accessed.

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SPOT THE MISTAKES!

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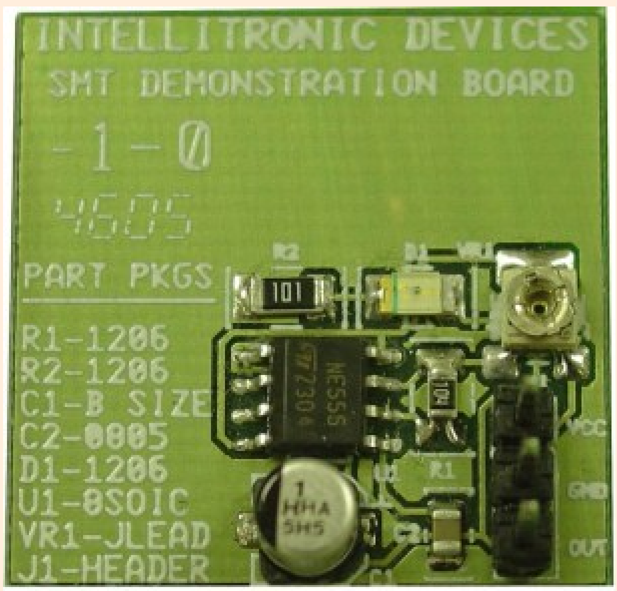
INDEX

The next discussion is not a mistake but an item that needs discussing.

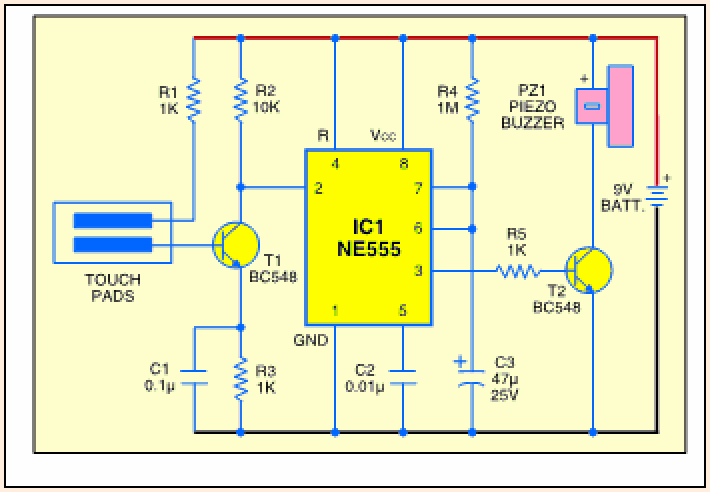


It is a 555 demonstration board.
It is designed to teach beginners how to solder surface-mount components. It should also teach how to lay out a circuit so it is easy to follow.
The circuit is an absolute jumble.
For a start, the power plug is not polarised and if it is inserted around the wrong way, the chip will be damaged.
It should be a 4-pin plug with the "OUT" terminal in the centre, so the GND pin can be at the bottom.
Secondly, the layout should follow the circuit diagram. For a simple project such as this, it would be much easier for the beginner to see each component in the same relative place as on a circuit diagram. This involves turning the chip around so it sits correctly, and placing the parts so you can where they belong, relative to the timing circuit.
These are the skills we are teaching on this website. The whole object of a good design is to make it easy to service the product - not create frustration.

Mat Switch

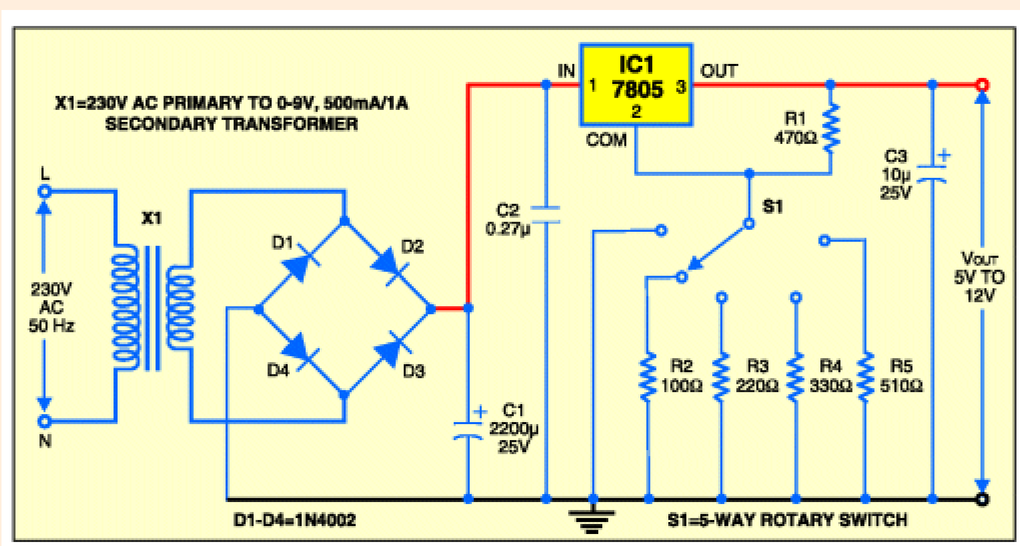
Here is a circuit from an Indian Magazine: "Electronics For You."
Take the following circuit for example. It is a MAT SWITCH and is designed to operate a Piezo buzzer for 50 seconds, after someone has put their foot on a mat.
The designer of the circuit has not thought "outside the box." The circuit uses a 9v battery. When at rest, the circuit draws at least 10mA. How long do you think a 9v battery will last?
What an absurd waste of current.
Now we look into the design faults:
The touch pads consist of conductive foam, such as that obtained from the foam used to pack sensitive

IC's.
The article suggests two small pieces of conducting foam. Where are you going to put small pieces of foam in a mat?
You will need a large piece if you want to guarantee to detect pressure.
The next point is: What is the purpose of the resistor and capacitor on the emitter of the first transistor?
Secondly: What is to prevent the base of the transistor floating and picking up static electricity and false triggering the circuit?
Thirdly: Why is the resistor on the base of the first transistor so low? It should be 10k to 100k.
Overall, the circuit serves no practical purpose. A 9v battery would be flat in a day. And at $2 per battery, how many Indians are going to replace the battery every day!
It makes you laugh!
We have designed a far-superior circuit using a CD 4001 or CD 4011 and it draws one microamp!



ADJUSTABLE VOLTAGE

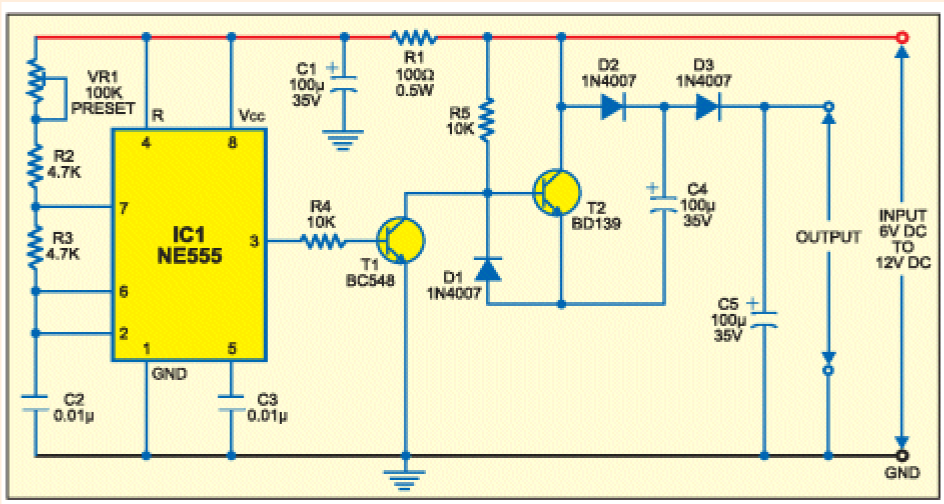
Here is another "Electronics For You" circuit. It has a very dangerous mistake. When the selector-switch is changed from one setting to another, the output temporarily goes HIGH and this puts a very high voltage on the equipment you are powering.
If you think a 9v AC transformer will provide 12v DC from a 7805, you are kidding yourself. The 7805 needs at least 2-3v for regulation and a 1amp transformer has a regulation problem of at least 1v. The circuit is a real disaster!

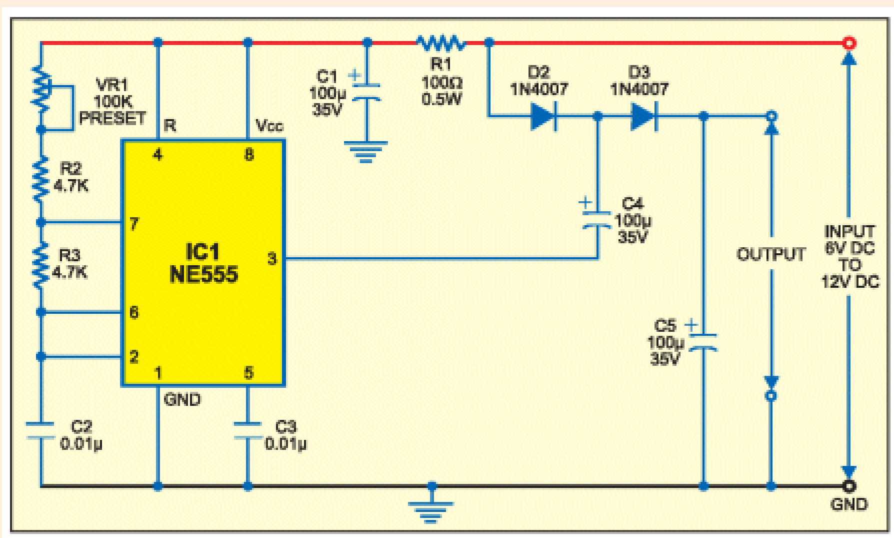


VOLTAGE DOUBLER

And yet another "Electronics For You" circuit. In fact every project from their website contains mistakes and designs that are far from the normal. The circuit below is a Voltage Multiplier. But the actual voltage-multiplying section is the part that concerns us.
The output of a 555 is capable of sinking and sourcing about 200mA and it can be connected directly to a "charge pump" as shown in the second diagram. This saves 2 transistors and 3 components. The only

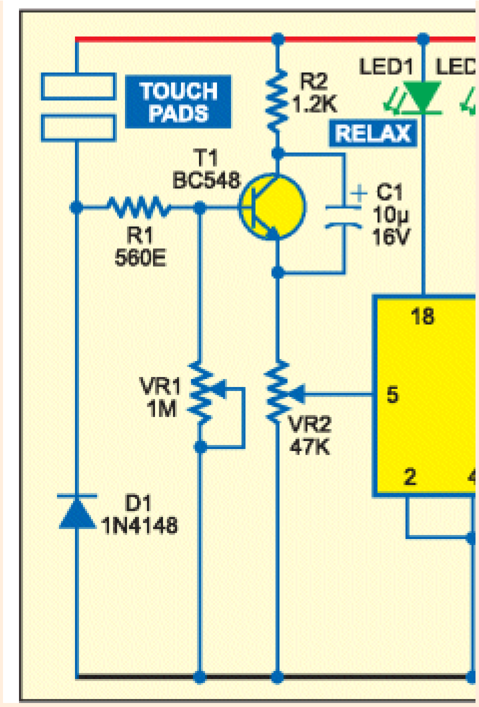
problem with using the output of a 555 IC is the voltage swing. The output rises to 2v below rail voltage and only goes to 2v above the 0v rail. In other words, you lose about 4v. This means the rail voltage for the project needs to be higher to get the required output voltage.
The author has used a BC 548 to charge the 100u, and a BD 139 to discharge it. Why use a "power transistor" to discharge the electro? It doesn't make any sense. Also, why use a 1N 4007 diode for a 12v circuit? The 1N 4007 is a high voltage diode. It looks like the author had a lot of junk parts in his parts-box and threw them into the project. This is the sort of "poor presentation" that I don't like, since a newcomer will wonder why each of the components has been chosen and will get a false understanding.





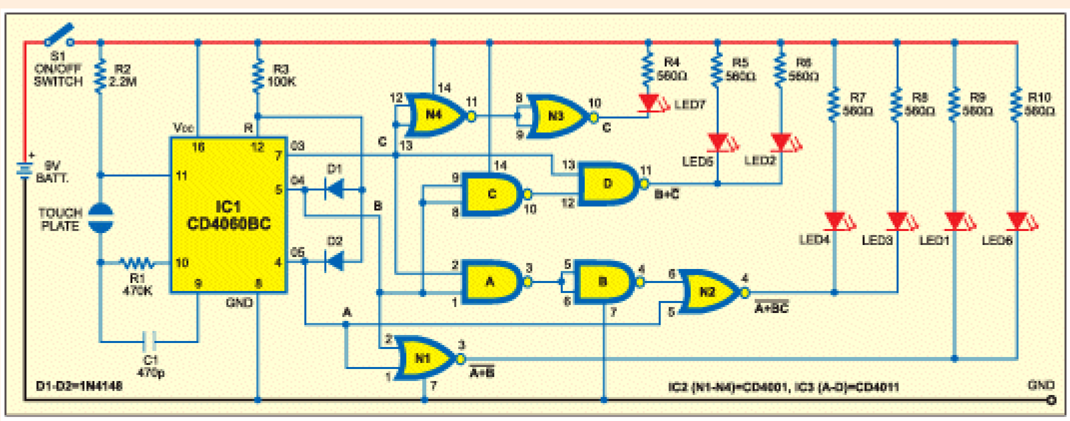
STRESS METER

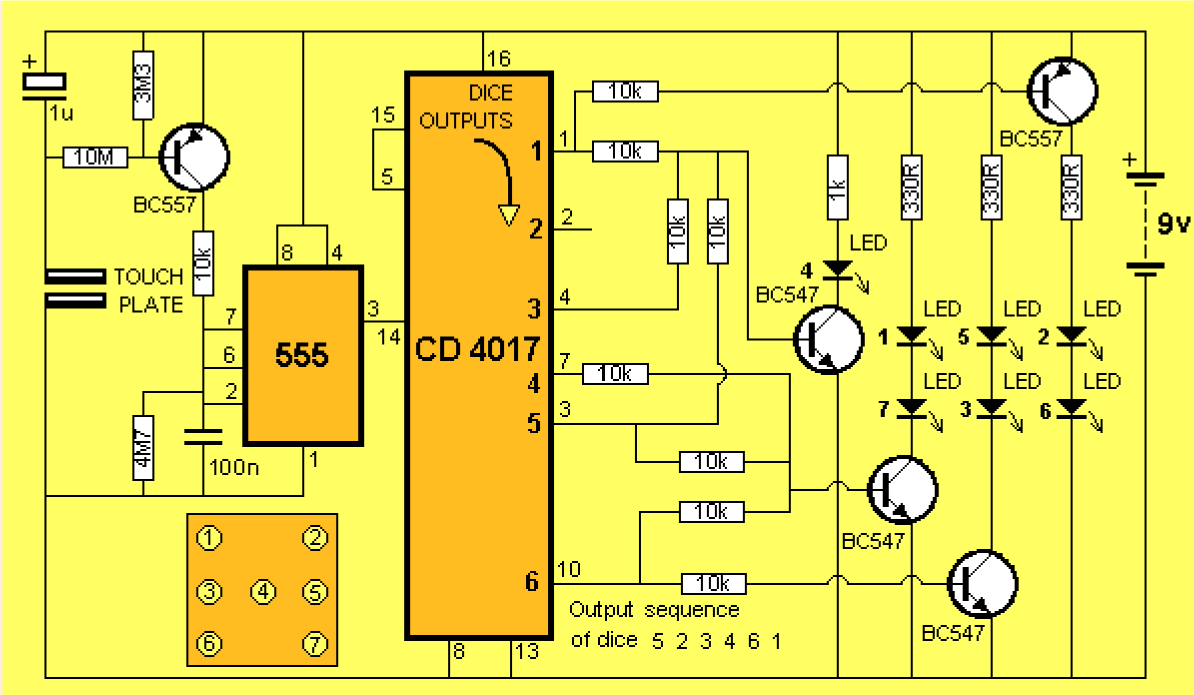
In the next circuit from EFY, we have a Stress Meter. The author claims the transistor is a common-emitter configuration, however it is actually an emitter-follower. But the point of this discussion is the purpose of the 560R resistor and diode.
The author claims they are biasing components, however they don't serve any purpose at all.
When designing a circuit, you need to go over every component and say "is this necessary?"



LED DICE

The next circuit uses "gates" (NAND and NOR gates) to drive a set of LEDs to form the spots on a Die or Dice. A CD 4001 or CD 4011 is not capable of delivering enough current to drive two LEDs in parallel. The brightness will be very small. The second circuit uses transistors to drive the LEDs. It only uses two IC's and has a slow-down feature.

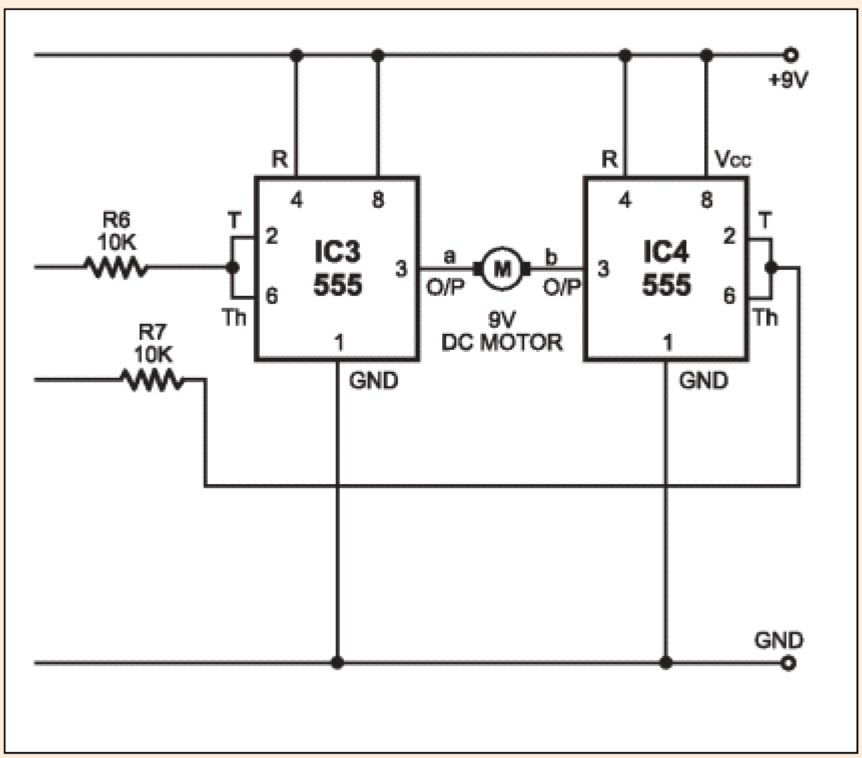




See our LED Dice project for more details on the circuit

Motor Driver

In the next circuit from EFY, we have a Motor Driver circuit:



The motor is driven from a pair of 555 IC's. Apart from the fact that 555 IC's can only deliver about 200-300mA, the maximum output voltage is about 2v lower than rail voltage. The "LOW" is about 2v above the 0v rail. This means the 9v motor will get a maximum of 5v from a 9v supply. The motor will deliver almost no torque at all.

I have written to the Indians who have designed these circuits and received no reply.

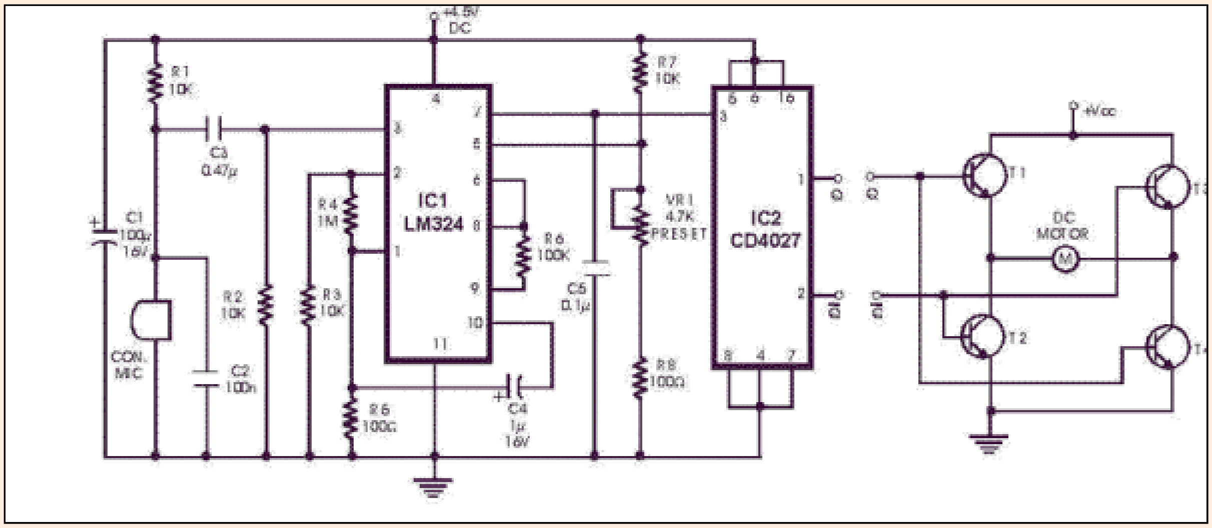
They have actually put these circuits into magazines with a readership of 500,000. Pity the poor readers!

None of the circuits I have presented, have ever been prototyped or used for a period of time to determine if they contain errors or problems.

This is one of the most important things for a design-engineer to do. He must test everything TO

DESTRUCTION!
Actually I am only kidding, but you must test everything for hours and hours and give samples to friends to try.

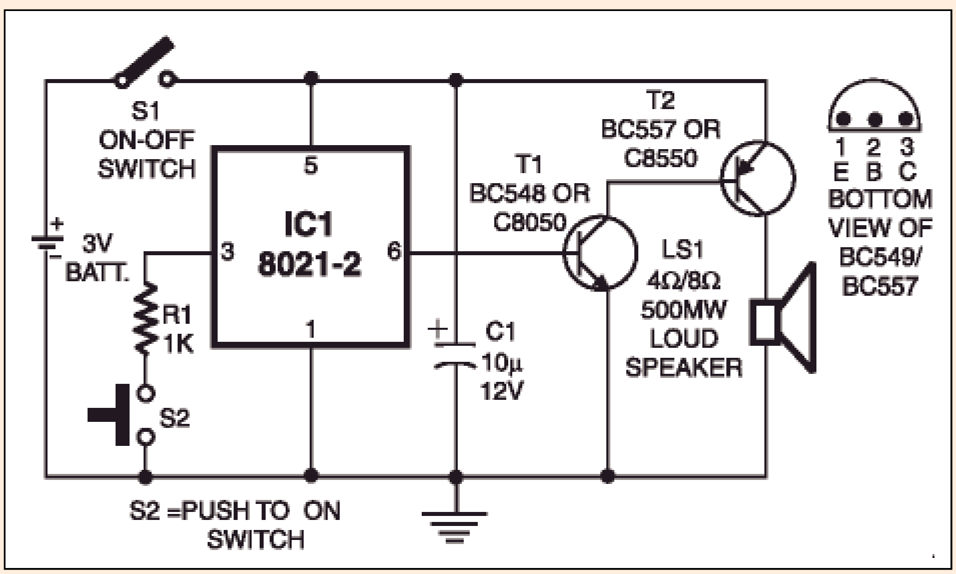
I could not resist the next EFY disaster:



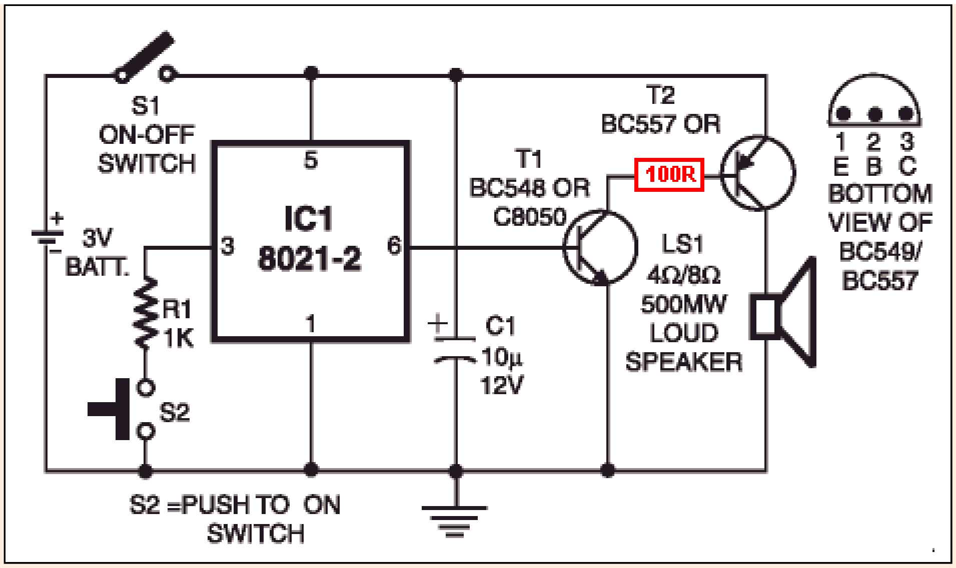
The circuit has an "H-Bridge" to drive the motor. The top left-hand transistor is an emitter follower. The base must be taken to nearly rail voltage so the emitter can rise and deliver a positive voltage to the motor. But the Q line is limited to a rise of 0.6v since it is connected to the base of the lower right-hand transistor!
This circuit obviously has never been constructed and unless you build a circuit and try it, you will be embarrassed too.

Music Chip

We have covered the next fault on page 4 of this article, but it is worth mentioning again.
It comes from EFY:



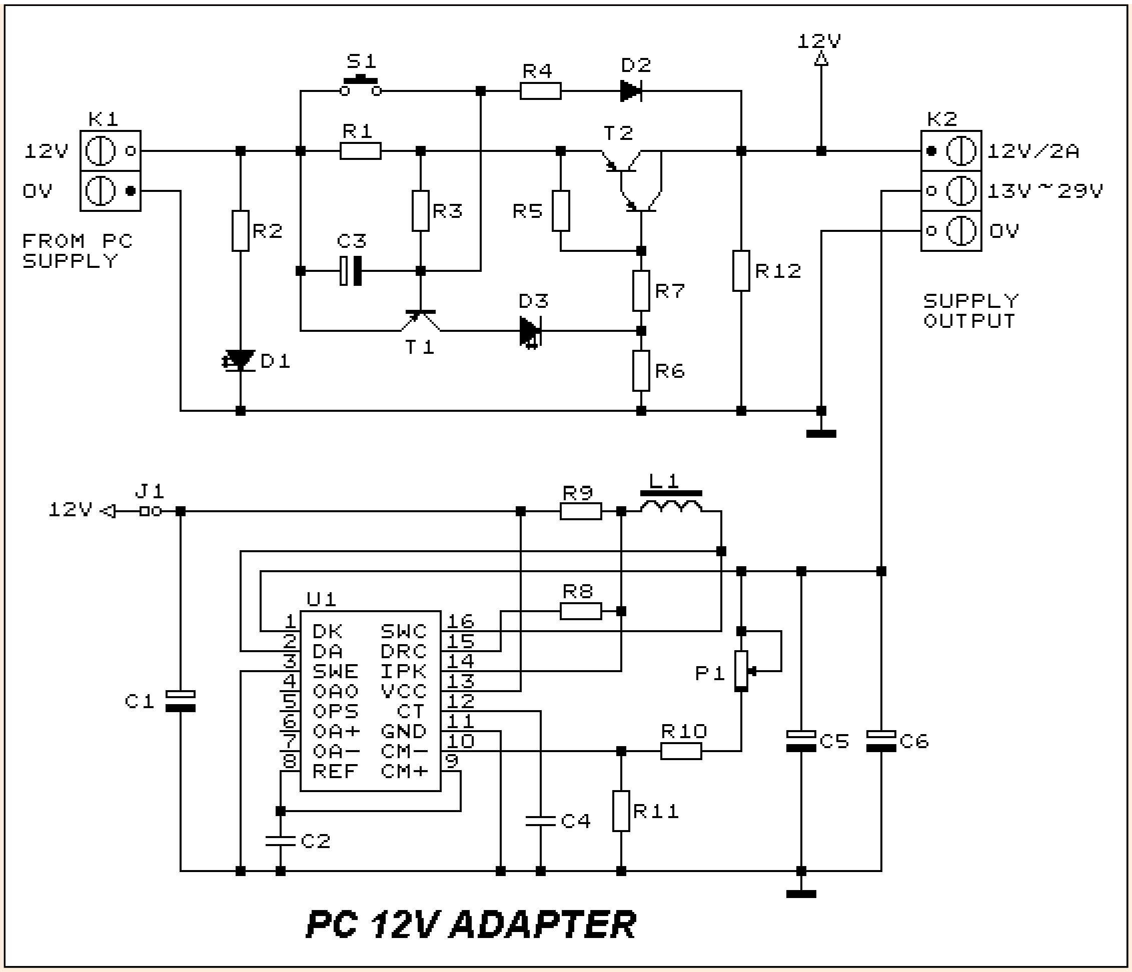
When the BC 547 transistor is turned on, the resistance between the collector and emitter is very low. The BC 547 turns on the BC 557 and the voltage drop between the base and emitter of the BC 557 is 0.7v. This means a high current flows across the base-emitter junction of the BC 557 and between the collector and emitter of the BC 547. A current-limit resistor is needed as shown in the diagram below. This will limit the current and yet allow the circuit to operate correctly.



Sometimes it is very difficult to "see outside the box." That's why you have to come back to a circuit and look at it over and over again.
I have seen lots of stupid circuits but I have also seen a lot of very clever designs.
To become a good design-engineer, you have to study thousands of circuits and see how and why they work. You also have to see the problems of "others" so you don't make the same mistake.

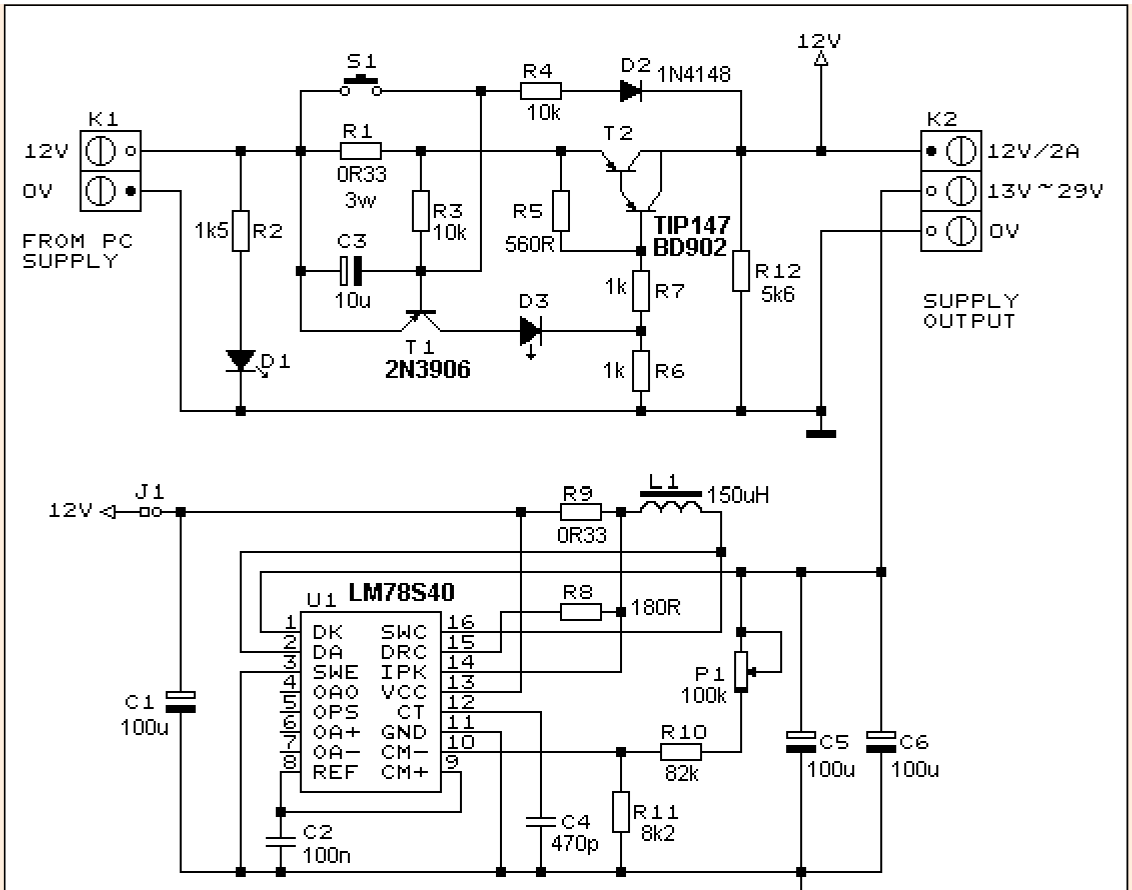
12v Adapter

The next discussion is a general mistake. The diagram below has no component values. When you look at the diagram, you have absolutely no idea how the circuit works as the value of each component gives you and idea of the current flowing and how the components are biased. The list of components has been placed on another web page and this makes diagnosis very difficult. A circuit diagram should be as complete as possible. It is difficult to see how you can get 12v out (after regulation) from a 12v supply.
The diagram below shows the component values added to the circuit.



PC 12V ADAPTER

Item	Quantity	Reference	Part
1	3	C1,C5,C6	100uF 25V LOW ESR
2	1	C2	100nF
3	1	C3	10uF 16V
4	1	C4	470pF
5	1	D1	LED GREEN 3mm
6	1	D2	1N4148
7	1	D3	LED RED 3mm
8	1	J1	JUMPER 2 PIN
9	1	K1	PLUG-IN TERMINAL BLOCK 2 WAY
10	1	K2	PLUG-IN TERMINAL BLOCK 3 WAY
11	1	L1	150uH TOROID CORE INDUCTOR
12	1	P1	100K MULTITURN
13	1	R1	0R33 3W
14	1	R2	1K5
15	2	R3,R4	10K
16	1	R5	560R
17	2	R6,R7	1K
18	1	R8	180R
19	1	R9	0R33
20	1	R10	82K
21	1	R11	8K2
22	1	R12	5K6
23	1	S1	PUSH SWITCH
24	1	T1	2N3906
25	1	T2	TIP147, BD902
26	1	U1	LM78S40



PC 12V ADAPTER

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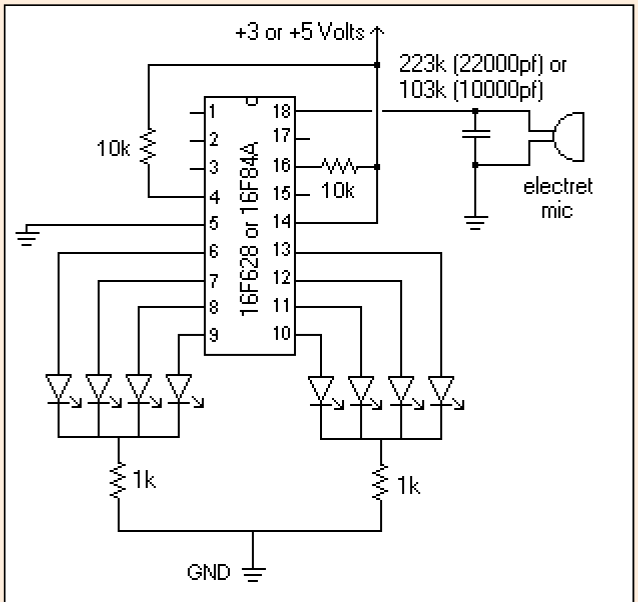
SPOT THE MISTAKES!

Page 6

Sound Meter

The next circuit has two problems.
Connecting an electret mic directly to the input of a microcontroller chip is an unwise thing to do. In the circuit below, the voltage across the microphone will never rise above 50% of rail voltage for the chip to detect a HIGH.
The other mistake is the 1k resistors on the LEDs.
At a supply voltage of 3v, the current through each 1k will be less than 2mA. It is not known if more than one LED illuminates at a time, but this current would be shared between 2, 3 or 4 LEDs and they would be barely visible. The resistors should be 100R to 220R.



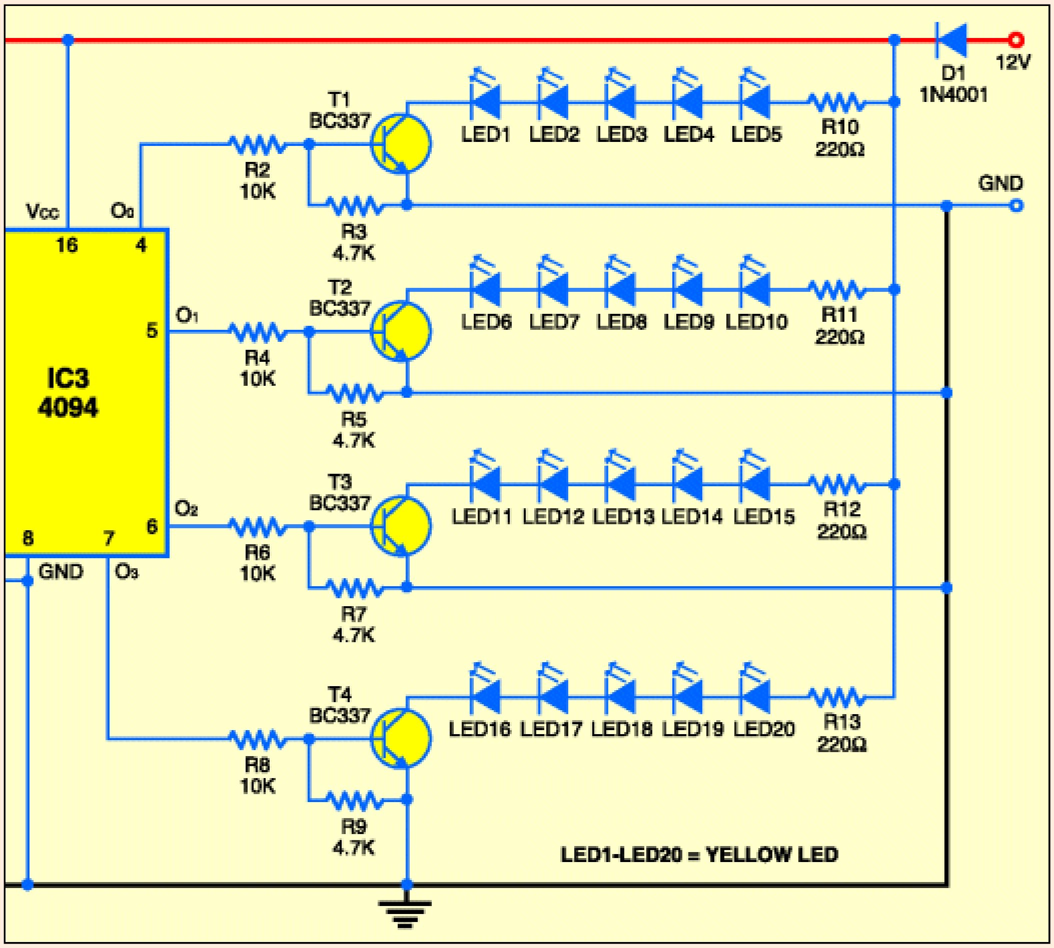
16F628 / 16F84A Soundmeter

More from EFY:

LEDs in Series

The LEDs suggested for the circuit are HIGH-BRIGHT yellow LEDs. These LEDs have a characteristic voltage-drop of 2v - 2.6v. The normal characteristic is 2.3v. The drop across the 5 LEDs is 11.5v. The transistor will drop about 0.3v between collector and emitter and the protection diode will drop about 0.6v. This makes a total of 12.4v. Where is the allowance for the voltage drop across the 220R?
What is the purpose of the 4k7 resistors on the base of each BC337? The output of the chip will produce either a HIGH or a LOW.

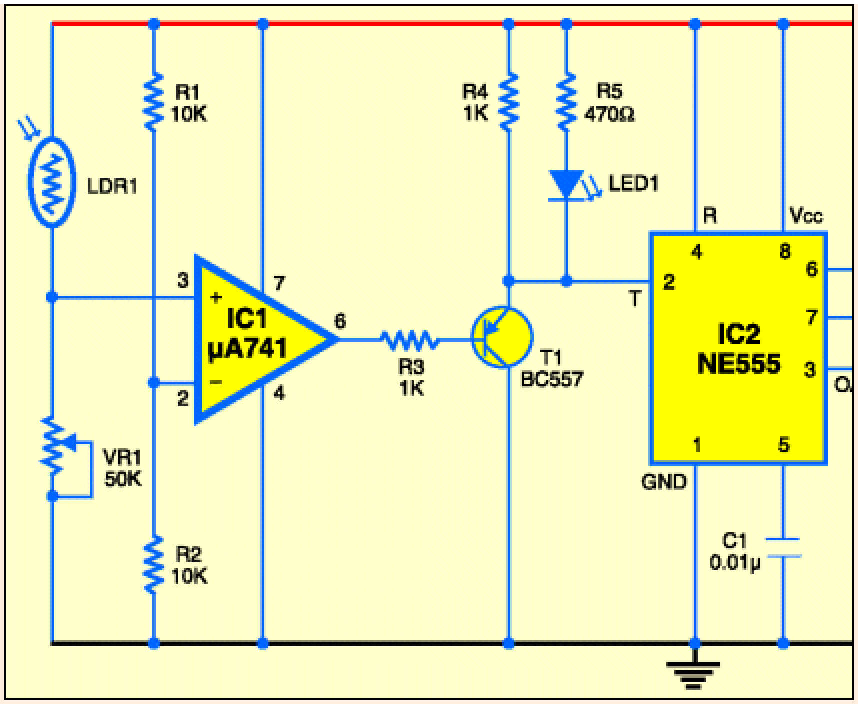
This is another circuit that obviously has not been tested.
I received a reply from Electronics For You Magazine. They stated their LEDs had a voltage drop of 1.95v and that's why their circuit worked!!
They missed my point completely. What about MY LEDs. And what about YOUR LEDs?
They only produced one sample in a laboratory. Big mistake. That's why I get others to build a project before I put it in front of 250,000 readers. The circuit does not work reliably.



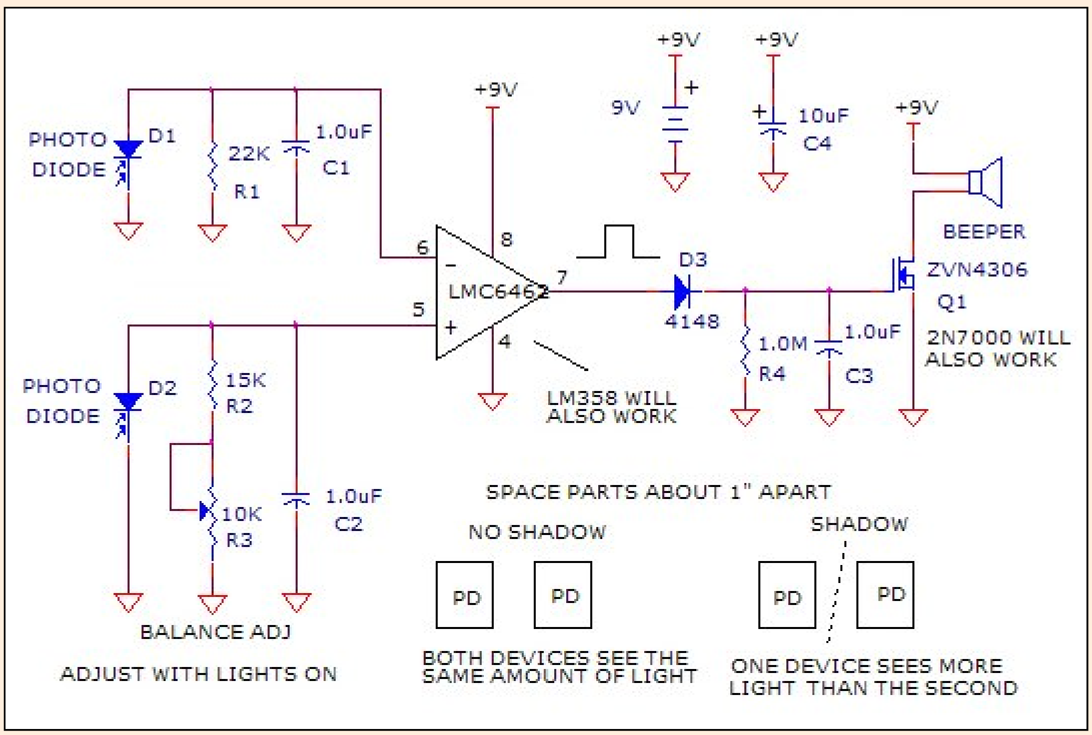
And still more from EFY:

1k load resistor

In the circuit below, what is the purpose of the 1k resistor?
The LED and 470R will hold pin 2 HIGH when the output of the OP-AMP is HIGH as the characteristic voltage across the LED is about 1.7v and pin 2 must drop below 1/3 of rail voltage to activate the 555.
But the main problem with the circuit is the single LDR to detect when a person enters a room. The circuit is sensitive enough to detect the shadow of a person passing the LDR but a circuit with this amount of sensitivity will also detect the ambient light level and false-trigger.
A much-better design is shown in the next circuit. It uses two photo-diodes to compare the background light level and only register when there is a difference. This allows the day to shine or the sky to overcast, without affecting the alarm.
The circuit has been bread-boarded and put into a movie HERE. (1Meg)



The improved circuit:



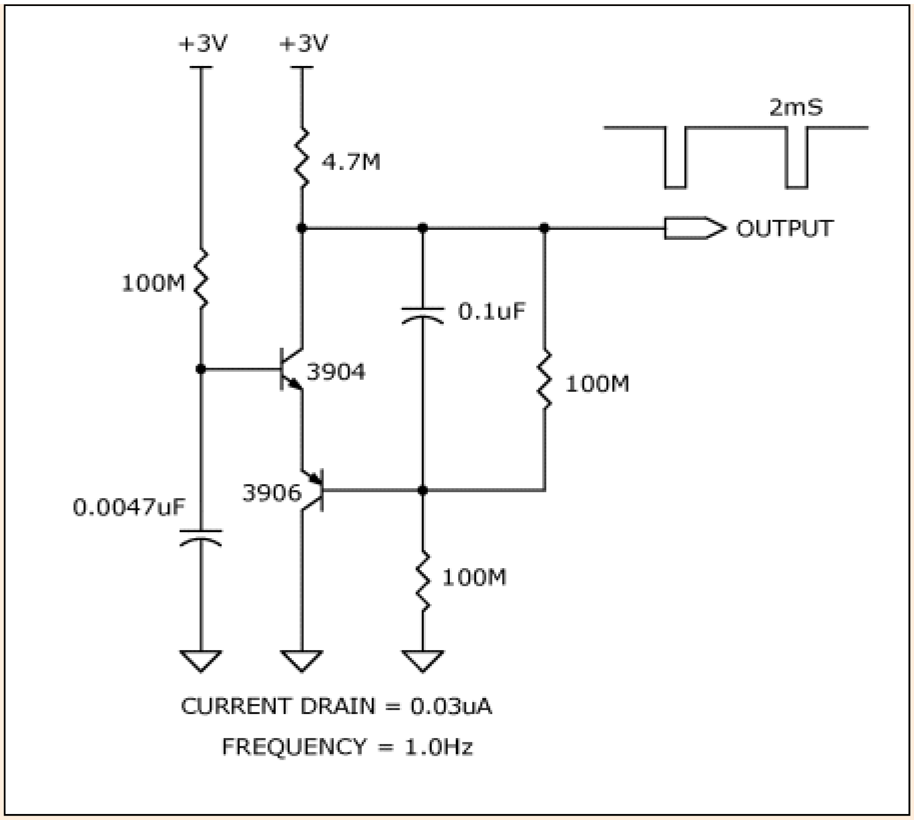
As I have said before. Ask yourself: Will the circuit work in all types of different conditions and surroundings? What is the purpose of each component? Is each component necessary? How much current does the circuit take in quiescent ("idle") mode? Are there better and cheaper ways to do the same thing?

That's why you need to study so many circuits, to get an idea of how to design the cheapest and best arrangement.
You will learn more for other people's mistakes than any text book on electronics.
Text books assume everything you construct will work.
After all, how many text books have a section "If it doesn't work?"
It's only when a project fails to work, that you will start to learn how the circuit works.

That's why you can never get enough "mistakes" to investigate and analyse.

Faulty Design

The next circuit is not a mistake but the author does not mention the output does not rise above 1.2v for a 3v supply. This is only a 40% rise and will not register as a HIGH, for many devices such as "gates" especially those with a Schmitt trigger input. They need at least 65% of rail voltage to detect a HIGH.
Secondly, the author has neglected to inform the output needs to be connected to a very high impedance to allow the circuit to rise to its maximum output.
The reason is the 4M7 in the circuit is the component that "pulls" the output HIGH and if the output is connected to a circuit with an input of say 4M7, the output will rise to less than 1v.
There is no problem with the oscillator producing a LOW as the two transistors are turned on by "regenerative action" and the output pulls LOW with considerable "force" or "ability" or "current."
The circuit starts its cycle by charging the 4n7 via the 100M resistor. The 4M7 and 100M and 100M form a voltage divider that put a small voltage on the base of the lower transistor.
The 4n7 charges and puts a voltage on the base of the upper transistor. The emitter of the upper transistor sees a voltage that is about 0.6v lower than the base and this voltage is placed on the emitter of the lower transistor. When this emitter voltage is 0.6v higher than the base, the transistor turns on and holds the emitter at its present potential. The transistor cannot pull itself closer to the 0v line as this would remove some of the "turn-on" voltage on the base.
However the lower transistor remains rigid and the top transistor turns on more as the 4n7 charges.
The voltage on the collector of the top transistor reduces and this pulls the top plate of the 0.1u capacitor towards the 0v rail. Since this action is happening very fast, the capacitor does not have time to charge and the bottom plate is also pulled towards the 0v rail
The bottom of the 0.1u is connected to the base of the lower transistor and this is also taken lower.
This turns on the bottom transistor and the result is the top transistor is turns on more. This is the regenerative action mentioned above and the two transistors turns each other ON more and more until the they are both turned on FULLY.
This whole action occurs without the need for the 4n7 to charge any further and that's why the action is called regenerative.
We now have the situation where the two transistors are turned on and the output is LOW. The very small voltage or "energy" stored in the 0.1u is now passed into the base of the lower transistor to keep it in this "turned-on" condition and this produces the 2mS LOW on the output waveform.
After 2mS, the lower transistor cannot be kept turned on and as soon as its turns off slightly, the top transistor is turned off slightly as well and the output rises. This happens very quickly and the top plate of the capacitor rises and takes the lower plate with it. This turns off the lower transistor and the two transistor are very quickly turned off fully.
As mentioned above, the output will not rise above 1.2v for a 3v supply and this must be taken into account when connecting it to another stage.

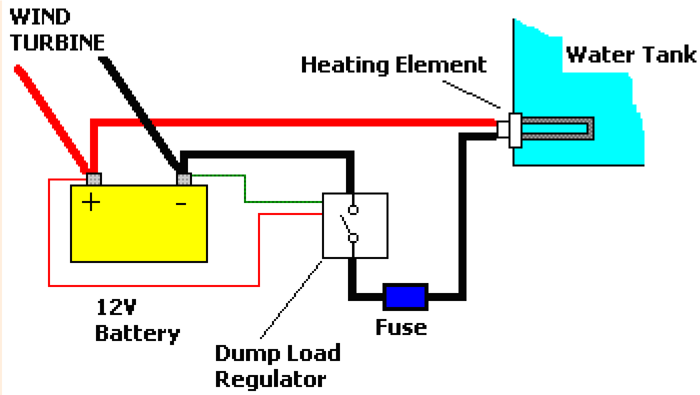


Wind Turbine Water Heating

Wind turbine generators are used primarily for electricity generation. The power used can be stored in a **battery bank** or connected to the mains. In very strong winds, and/or when the batteries are fully charged a wind turbine may generate more current than the batteries can handle. Therefore a *dump load* is often used to divert the extra energy to heat water so it is not wasted and so that the wind turbine does not spin so quickly that it is damaged.

Diversion Load Water Heating

Pictured above is a typical **12V water heating element** (200 Watt power). When used as a diversion (dump) load, such an element is connected to the batteries via a charge regulator. When the **regulator** detects that the batteries are fully charged, it diverts the generated electricity to the **element** which heats water.



Direct Wind Turbine Water Heating

It is not usually possible to connect a 12 Volt water heating element directly to the output from a **wind turbine**. The voltages generated by a 12 Volt wind turbine are typically far in excess of their nominal 12 Volt rating - values of over 50 Volts can often be recorded in heavy winds which would rapidly burn out the heating element when you need it most.

In order to prevent the **heating element** from receiving fluctuating *over-voltages* a small battery should be used as a **buffer** between the wind turbine output and the heating element. A **12V motorcycle battery** is perfect for this task - no more powerful than 4 amp hours / 50 cold cranking amps, and it should be a lead-acid battery which can be refilled with water. A sealed gel type battery or dry cell should not be used.

The **heating element** chosen must be closely matched to the power output of the wind turbine. If the element is too small (low wattage), then too much power will go through it and it may be damaged. If it is too large (high wattage), the wind turbine will not be able to start up spinning unless the wind is very strong.

The only fault with the article is the mention that a small heating element will be damaged if placed in the circuit above. **This is not true**. If a low-wattage element is placed in the circuit, it will only draw (take) its rated wattage as the maximum voltage is limited to 12v via the 12v battery.
But the rest of the statements are true and worth noting.

More on Wind

While on the topic of wind generation, a supplier of wind generators provided absolutely no wattage output from his generator, but a simple voltage produced at various RPM:

Delta Connected

Model Number	AC(V) per 100 RPM	DC(V) @100RPM	DC(V) @ 300RPM	DC(V) @ 500RPM
RC1100-10	4.2	5.9	18	30
RC1100-14	5.6	7.9	24	40
RC2200-20	8.5	12	36	60
RC2200-105	44.0	62	187	311
RC2200-125	50.0	71	212	354

Star Connected

Model Number	AC(V) per 100 RPM	DC(V) @100RPM	DC(V) @ 300RPM	DC(V) @ 500RPM
RC1100-10	7.0	9.9	30	49
RC1100-14	10.0	14.1	42	71
RC2200-20	14.0	19.8	59	99
RC2200-105	76.0	107	322	537
RC2200-125	90.0	127	382	636

Note1: DC (V) measured after rectification
Note2: Voltages shown are open circuit voltages, for comparison only

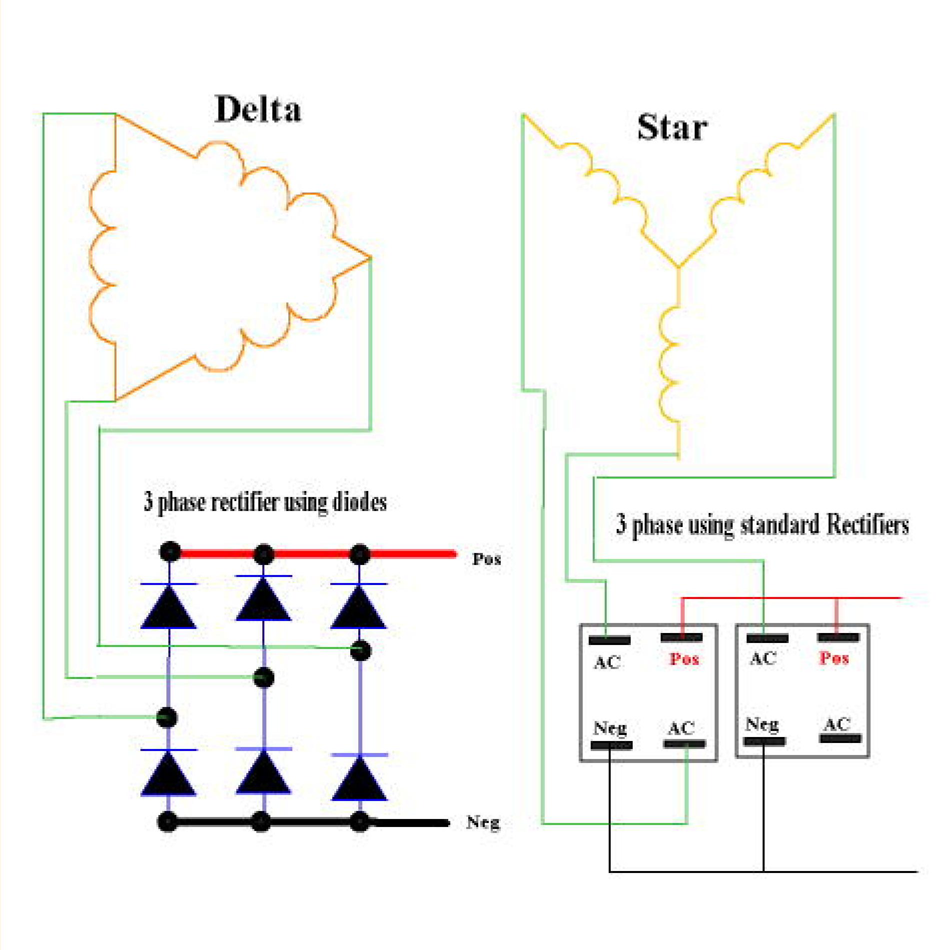
I emailed him and said a voltage output did not provide any information what-so-ever as to the energy delivered by the generator.

His reply was as follows:

The comparison chart only shows the relative comparison of open circuit voltage versus RPM for each PMG in both Star and Delta configuration.

It would not be possible to show the current at each of these speeds, without knowing the applied torque at those same RPMs, and since these generators are supplied to customers for a variety of applications, there is no "standard" torque which can be used to best demonstrate the current (and hence overall power) of the generators at all speeds.

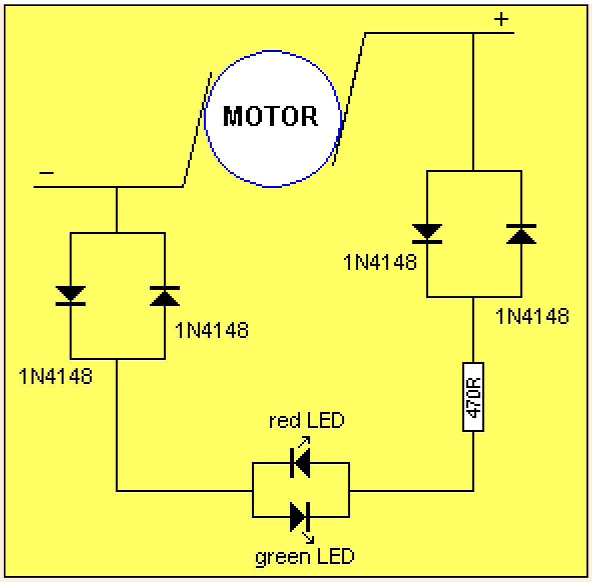
What he is saying is totally untrue. You do not have to know the input torque and, in fact the input torque is not needed or wanted.
The way to test the generator is to place it on a test-bed and connected to a variable speed motor to the drive-shaft. Bring the motor up to 100RPM and measure the voltage at no load. Place a load on the motor of 1 amp and note the RPM will decrease. Increase the RPM to 100 and measure the voltage.
Do the same for 2, 3, 4, 5, 6, amp etc and you will find the voltage will drop off as the current increases. When you multiply the voltage by the current for each of the set of results, you will come up a value that is almost constant! This is the wattage deliverable by the generator at 100RPM.
Do the same for 200, 300, 400, 500, 600RPM and you will have the capability of the generator.
Not once did we mention anything about the torque or "power" entering the generator.
You can do this for star and delta wiring and tabulate the results.
Here is a diagram of how to connect the six wires that emerge from the generator:



There are basically two ways to wire a 3 phase alternator, star (or Wye) and Delta. With Delta you get a lower voltage but a higher current. In star you get a higher voltage but less amps. You can calculate these by using the square root of 3 (1.732). Each coil set is a "phase" of the alternator so when you measure voltage, ohms or current of one phase of the alternator you measure the "phase". Once you know what the output will be from one phase you can calculate the "line" output in either delta or star. The line voltage would be measured from any 2 of the 3 outputs. If one phase measured 22 volts and 10 amps then the star configuration would produce 38 volts and 10 amps (22 x 1.732). The amps remain the same as the phase measurement because the star is basically in series to another phase. In Delta you would get 22 volts at 17.32 amps (10 amps x 1.73). If you calculate this: 22 volts x 17.32 = 381 watts and 38 x 10 = 380 watts... so what is the advantage?
Typically the resistance in Delta is 1/3 the resistance of star. If the resistance of star was 1.5 ohms we could calculate the output. Lets assume the test was at 600 rpm, we achieved 38 volts in star so at 1000 rpm we would get 62.5 volts less battery voltage of 12.6 = 49.9 volts / 1.5 ohms = 33.26 amps * 12.6 = 419 watts... not too bad. Now in delta we had 22 volts at the same rpm. So at 1000 rpm we get 37 volts - 12.6 battery = 24.4 volts / .5 ohms = 48.8 amps * 12.6 = 614 watts. Almost a 200 watt gain !!! The advantage of star is the higher voltage at lower rpm which means our unit would have to reach 201 rpm to start charging at 12.6v while the Delta connection would require 340 rpm to start charging.

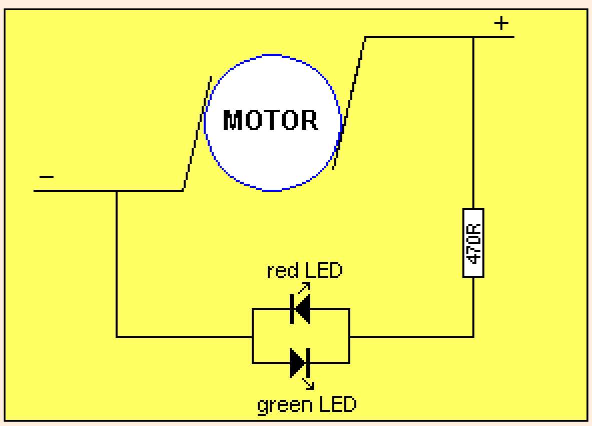
3 phase power is typically 150% more efficient than single phase in the same power range. In a single phase unit the power falls to zero three times during each cycle, in 3 phase it never drops to zero. The power delivered to the load is the same at any instant. Also, in 3 phase the conductors need only be 75% the size of conductors for single phase for the same power output.

Now we come to a very simple fault. The two LEDs are designed to identify the direction of rotation of the motor.



Why has the designer put signal diodes in the circuit? The Light Emitting Diode is a DIODE and will only conduct when the voltage is in the correct direction.
The additional signal diodes do not perform any function at all. It is surprising the editor of the magazine did not see this when reviewing the article.

The corrected diagram is:



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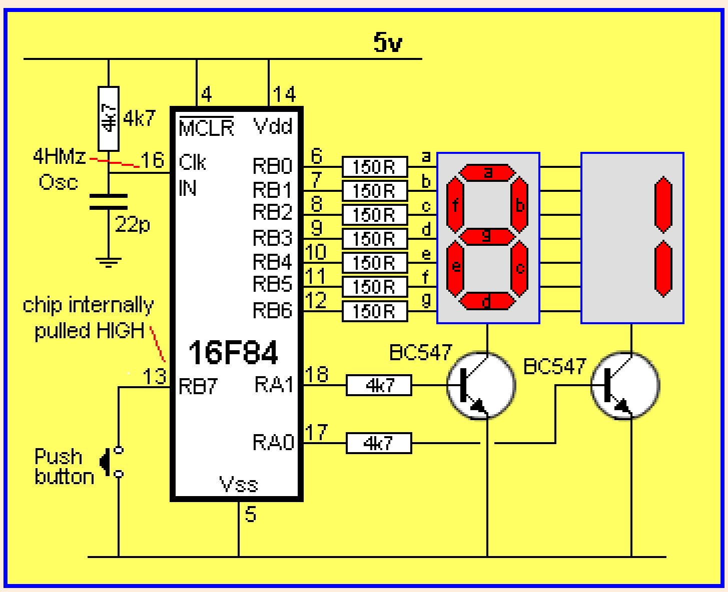
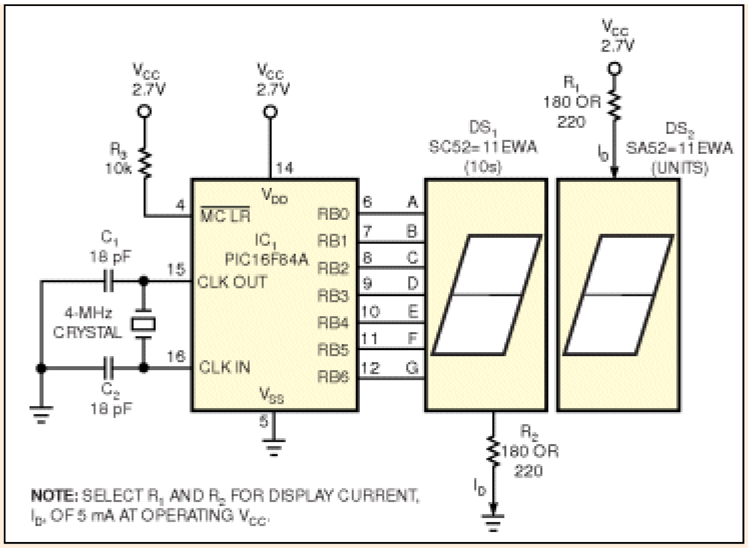
INDEX

2-Digit Display

The next circuit has a number of problems. It is possibly the worst "2-Digit Display" project I have seen.
The main fault with the design is the "on time" for each segment. To explain this, we will need to cover some background theory.
When two displays are connected to a microcontroller, only one display can be illuminated at the a time.





Ultralow-cost, two-digit counter features few components

Two seven-segment displays and one microprocessor count from zero to 99.

Noureddine Benabadji, University of Sciences and Technology, Oran, Algeria; Edited by Brad Thompson and Fran Granville -- EDN, 8/17/2006

The ultralow-cost, two-digit- counter circuit in **Figure 1** represents an attempt to reduce the number of components using a mostly software approach and a low-cost microcontroller, the PIC16F84A. The circuit lacks the current-limiting resistors that normally connect to a seven-segment LED display's pins because a software routine lights only one of the display's segments at a time, first in the 10s display and then in the units display. Doing so keeps the circuit's maximum current consumption at a nearly constant level, even if you add a third LED display to implement a three-digit counter. The circuit also lacks digit-selection switching transistors that classic multiplexed circuits' switching transistors typically use, and the circuit includes one common-cathode and one common-anode display. The reason for this approach is that each of the microprocessor's I/O Port A and Port B lines can assume one of three states: high, low, and floating—that is, high impedance. Programming a line as an input places it in a high-impedance state, which turns the display off.

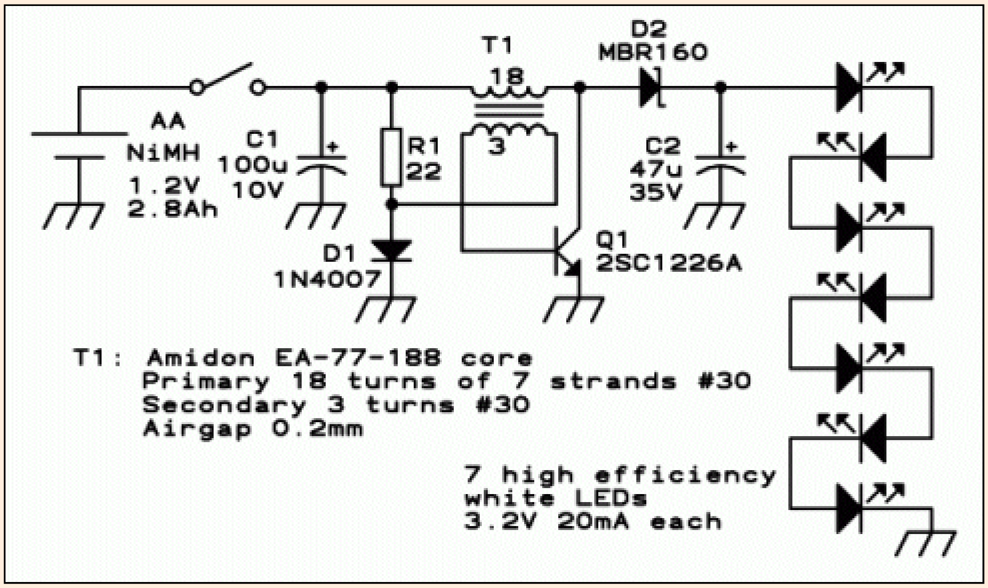
In addition, the program drives only one segment at a time and executes the following sequence: To drive the 10s display, program the line RB0 output and drive it high to light the corresponding segment of the common-cathode display and then program RB0 as an input. Repeat this procedure for lines RB1 through RB6. To drive the units display, repeat the process while applying a low output from RB0 to drive the common-anode display. **Figure 2** shows the circuit's timing diagram. The prototype display uses Kingbright's SC52-11EWA (DS_1) and SA52-11EWA (DS_2) high-efficiency, seven-segment displays that emit 2000 to 5600 µcd at a forward current of 10 mA. At a forward current of approximately 5 mA, the displays remain readable.

Early motion pictures displayed at an 18-Hz rate, which produces marginal flicker. The software executes at a rate of 180 Hz, or 10 times the minimum flicker rate. Each of the display's seven segments must illuminate for an interval of 1/(180×7) sec, or approximately 0.8 msec. To simplify the timing routine (section Delay3 of **Listing 1**), the software uses a refresh interval of 1 msec.

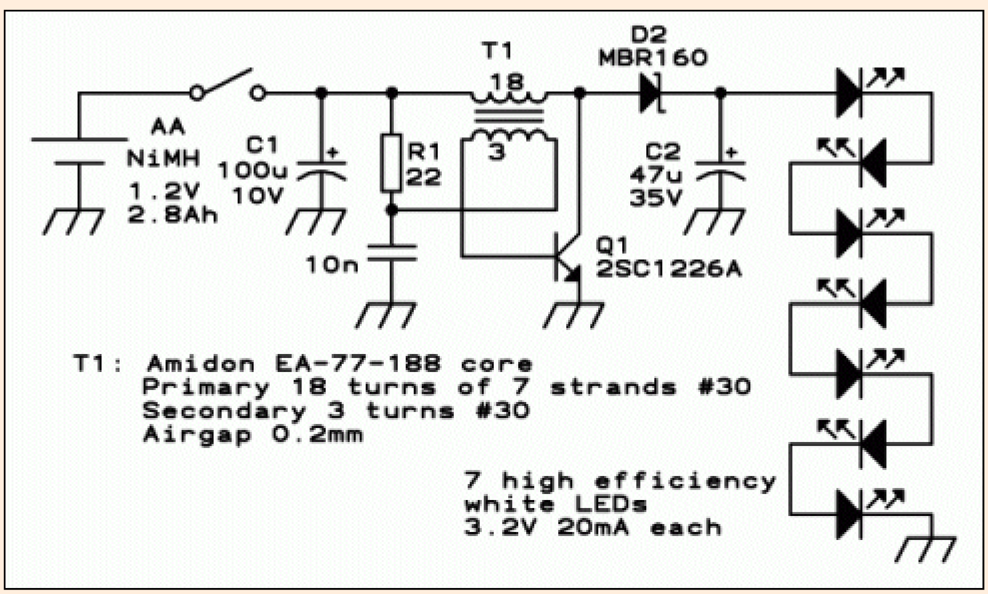
Although this approach provides adequate segment-drive current, the display's internal LEDs carry a 3V maximum reverse-voltage rating. Driving any I/O line high applies forward bias to one segment of the common-cathode digit but applies reverse bias to the corresponding segment of the common-anode display. The 16F84A requires a minimum of 2V for operation, and thus the circuit must operate in a 2 to 3V power-supply range. The assembler source code in **Listing 1** counts from 0 to 99 sec and serves as an unoptimized proof-of-concept software test bed for the display.

A Joule Thief Circuit

The next circuit has a major fault. It revolves around diode D1. Can you see the problem?



Diode D1 is drawing 23mA via the 22R for part of the cycle for no good purpose. It is intended to prevent "lock-up" when the circuit is turned on, but this can be achieved with a capacitor. By substituting a 10n capacitor for the diode, this current is not consumed and the efficiency is increased.
The capacitor will prevent "turn-on" voltage (produced by the feedback winding), entering the 22R and being "lost." All the turn on voltage (current) will enter the transistor and turn it on harder.
The 22R is a very low value and when the circuit is changed to drive the LEDs with AC, the current needed will be less than half. This will require a complete re-design, so I will not go into the circuit any further.
With 16,000mcd white LEDs costing only a few cents (less than 10cents from the manufacturer), a small LED torch needs only 2 or 3 LEDs, so this type of circuit can be changed to suit.



By referring to our article on [LED Torches](#) you can see how to produce a more-efficient circuit by supplying AC to the LEDs.

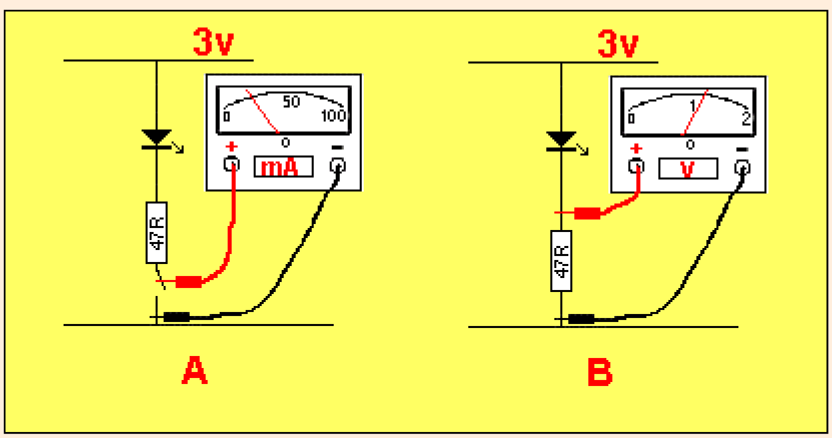
Here's a photo mistake. Can you spot the mistake?

The boy is soldering a "Solderless Breadboard!"

Measuring Current

The next mistake is the sort of help I like to give:

A customer was measuring the current through a LED as shown in diagram "A."
He should measure the current via diagram "B." We will explain WHY.



The LED and resistor create a low-impedance circuit. This is due to the fact that 47 ohms is a low value. If we measure the current through the 47R with a meter switched to mA, the multimeter will have a small resistance inside it that will add to the 47R. If this resistance is about 4 ohms, it adds about 10% to the 47R and thus the current through the circuit will be less. If the meter reads 25mA, when the resistor is re-connected, the current through the LED will be slightly more than 25mA.
In other words, the reading on the multi-meter in "A" is less than the true value.

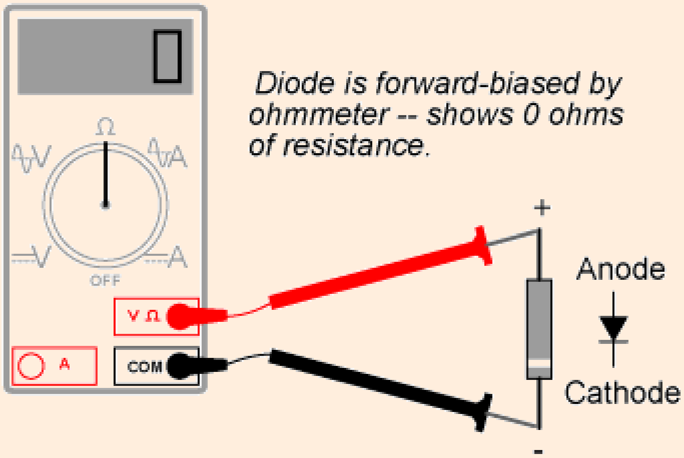
This is not important if you have one LED, but if you are creating a strip of 350 LEDs, an increase of 2mA, will change the overall wattage of the strip considerably.
The way to measure the current though the resistor is to take a mV reading and use Ohms Law to provide the answer. If the reading is 1.175v, by Ohms Law, the current is 1.175/47 = 25mA.

Measuring A Diode

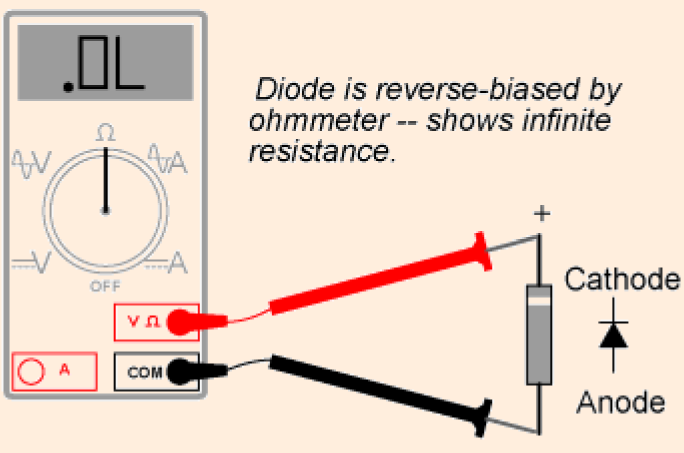
Here's a mistake from an ebook on the web. Corrections are in red.

Meter check of a diode

Being able to determine the polarity (cathode versus anode) and basic functionality of a diode is a very important skill for the electronics hobbyist or technician to have. Since we know that a diode is essentially nothing more than a one-way valve for electricity, it makes sense we should be able to verify its one-way nature using a DC (battery-powered) ohmmeter. Connected one way across the diode, the meter should show a very low resistance. Connected the other way across the diode, it should show a very high resistance ("OL" on some digital meter models, meaning "Open Load"):



A digital multimeter will NOT measure zero ohms across a diode. It will produce a value very similar to the diodes voltage drop in millivolts. This value will not be a true indication of the voltage across the diode when it is conducting full current.



Of course, in order to determine which end of the diode is the cathode and which is the anode, you must know with certainty which test lead of the meter is positive (+) and which is negative (-) when set to the "resistance" function. With most digital multimeters, the red lead becomes positive and the black lead negative when set to measure resistance. However, this is not guaranteed for all meters. Many analogue multimeters, for example, actually make their black leads positive (+) and their red leads negative (-) when switched to the "resistance" function, because it is easier to manufacture it that way!

LED Current

Another circuit from **Electronics For You,** an Indian electronics magazine.

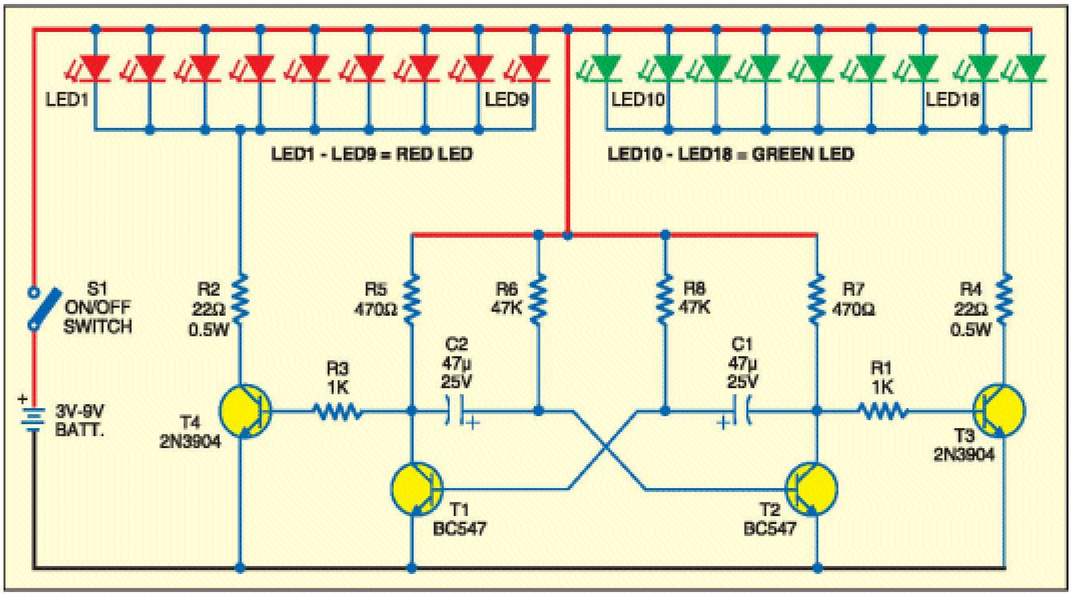


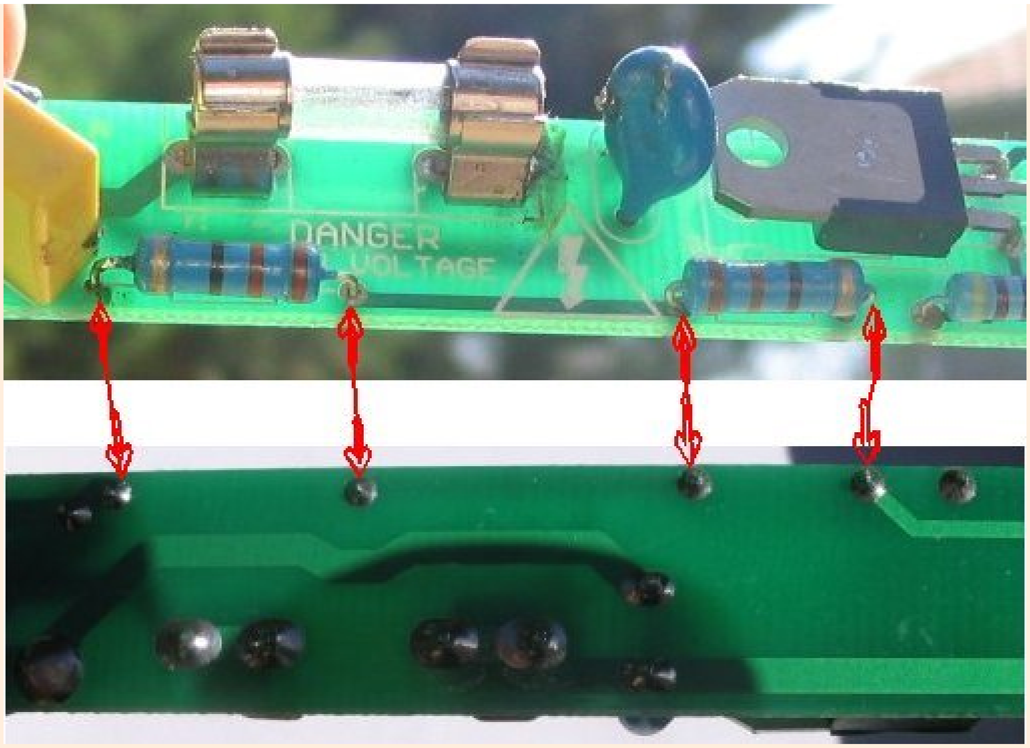
Fig.1: LED lighting circuit for Christmas

Suppose we use a 9v battery or 9v supply. The current through the 22 ohm resistor will be about 310mA, if we assume a red LED drops 1.7v and transistor T4 drops about 0.35v between collector and emitter.
This 310mA will be divided between 9 LEDs = 34mA for each LED. This current is very high and totally unnecessary to illuminate a LED.
But more important, a LED has a characteristic voltage that is dropped across it when it is placed in a circuit.
Each LED has a slightly different characteristic voltage and this causes a set of LEDs in parallel to take a slightly different current for each LED. You will find some LEDs will glow bright while others will hardly glow, even though a very high current is available.
This type of arrangement is totally unsuitable.
If 9v is available, 3 LEDs should be placed in series with a dropper resistor and the other 6 LEDs placed in groups of three with individual dropper resistors.

The moral to the story is this: Before designing and releasing anything, build the circuit and make tests. Get others to check the design and test the circuit to destruction!

Thermal Conduction

Here's a problem that stumped the experts.
Refer to the photo. The problem exits with the two 330R 1 watt resistors in series from a set of 100n capacitors forming a capacitor power supply on 240v mains.
One of the resistors is getting **very very** hot, while the other is getting hot. The two resistors are identified in the photo. Exactly the same current flows through each resistor and it is a mystery why one resistor is getting hotter than the other.
One suggestion was due to spikes, but this was ruled out. The problem was heat-sinking due to lack of track-work. The tracks and lands were not sufficient for the heat being generated in each resistor. This slight problem cost the company a fortune. The cost of the design was $8,000. The cost of manufacture of 2,000 modules was $7,000. The cost of fitting them into freezer doors was $3,000. And now the cost of removal and replacement will cost more than $100 per item as the doors are now at locations around the world! The modules cannot simply be extracted as they are built into the frame of the doors. It requires a serviceman to remove the door, pull the frame apart and refit a modulator. A simple thing like this can send a company "to the wall."



The Inductor

The next discussion comes from a reader. The photo shows the board from a battery tester. It shows "good" on a green LED or "replace" on a red LED for either a 1.5v cell or 9v battery. The item in question is the yellow coil. It has three wires and the readings are:

Pins 1 and 2: 1.6 ohms 108uH
Pins 1 and 3   0.6 ohms 18uH
Pins 2 and 3 1.2 ohms 48uH
The reader asks if he can replace the coil with two separate coils.

The answer is NO.
The "coil" is a transformer and it steps up the voltage from the 1.5v cell to drive the LEDs.
The circuit uses a 1.5v supply (a single cell) to generate 5v and this is regulated by a 5v zener diode.
See our [5v regulated Solar Power Supply.]

The transformer can be made by winding say 15 turns on a ferrite core and 40 turns over this, for the secondary. The connections will have to be correct for the circuit to work and this can be determined by referring to the project above.

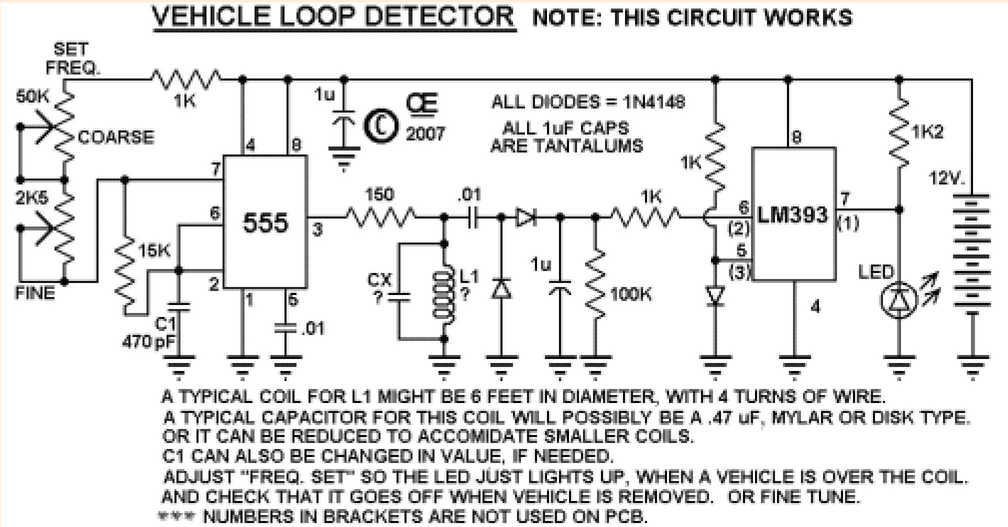
000000 000 000000

Circuit Mistakes

Next we have a common mistake from many designers. They turn off a device by "shorting-it-out."

In the circuit below, the output LED is around the wrong way, but more important is its placement. When the output of the chip is low, the LED does not illuminate. Approx 10mA (via the 1k2 resistor) passes to ground via the chip. If the project is supplied by a battery, this current is wasted.

When the output of the chip (a comparator with open collector) is HIGH, the current from the 1k2 is passed to the LED. Fortunately, this chip is a comparator with open collector. But if you try this idea with a high current chip such as an op-amp, things will be different and the LED will be destroyed.



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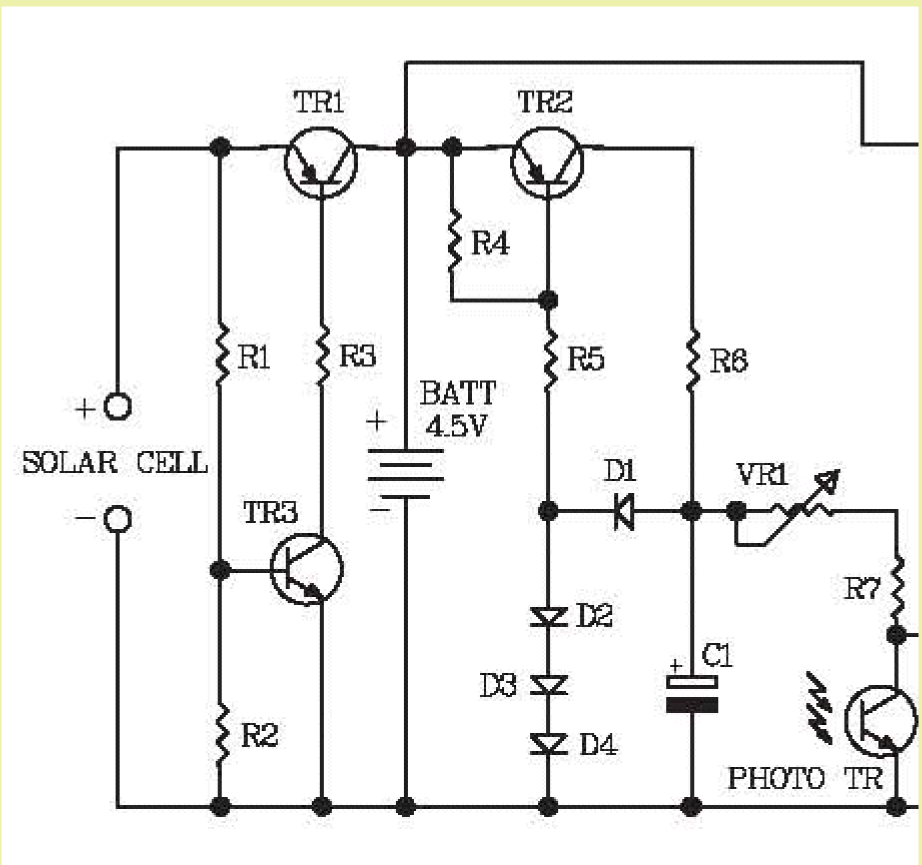
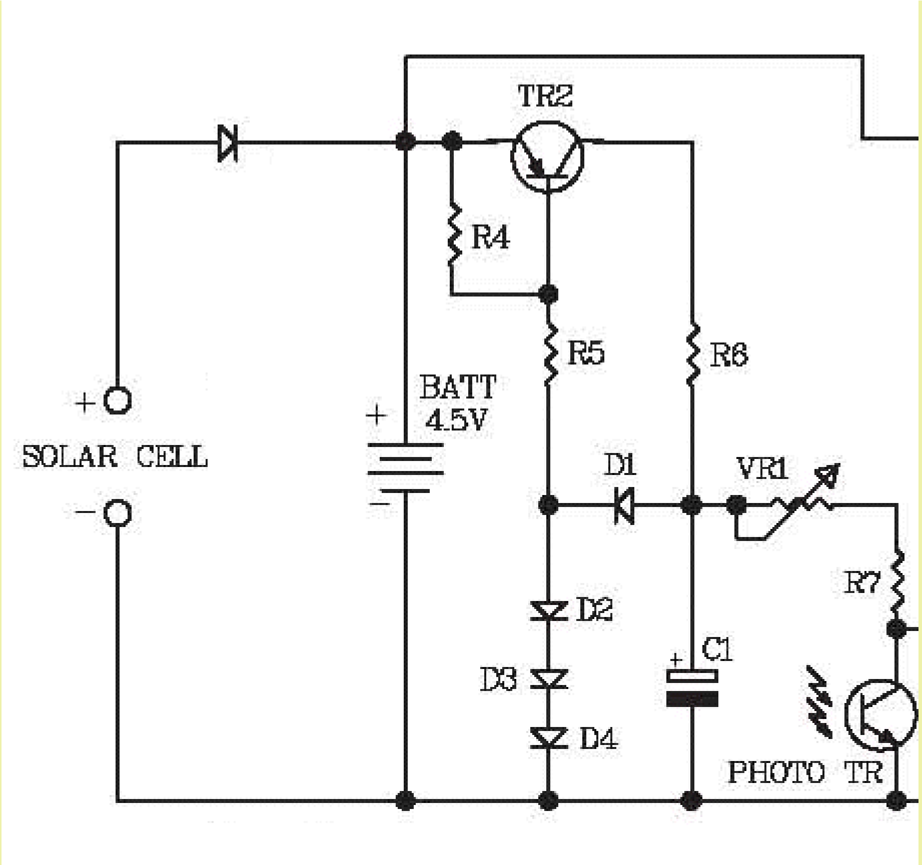
The next mistake is simply "over-complexity" from a kit by Future Kit, a Thailand firm. Look at the first two transistors on the solar charger circuit. They are intended to turn on when the voltage from the solar cell is greater than the voltage of the battery. But a simple diode can be used to do this. That's why you need more than one person to design and test anything you are making. A simple mistake like this can easily slip through and cost you a lot of embarrassment and expense. We have already shown on previous pages, that components can quire often be omitted at great saving to the manufacturer.



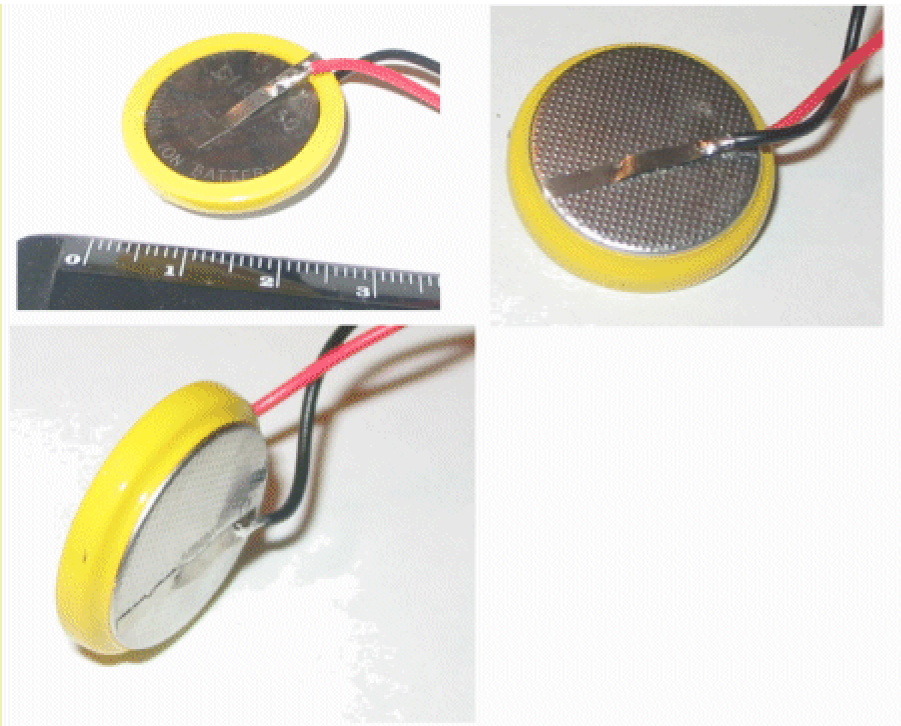


WIND-UP TORCH/RADIO

Now we come to a very nifty product: A wind-up radio and torch. It consists of an FM radio and a 3-LED torch.
The comment in the advert says: 1 minute of winding will light the torch for more than 10 minutes. This is incorrect. Let's find out why:

Wind-up Torch/Radio

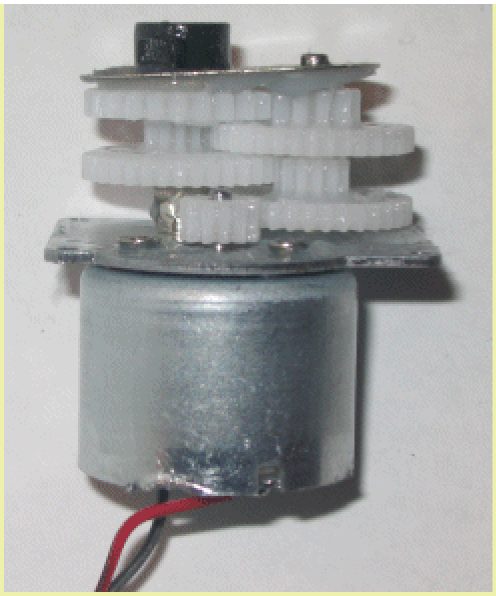
The interesting components in the product are the hand-cranked generator and 3.6v Li Ion 450mAhr battery.
This battery is just 25mm diameter and 5mm thick. If you remember the old Ni-Cad AA cells, they were about 450mAhr capacity and had an output voltage of 1.2v. This cell is equal to 3 of the old Ni-Cad cells!



Close-up of the 3.6v Li Ion 450mAhr cell

3 Ni-Cad cells supplying 3.6v 300mAhr

But the purpose of this discussion is to point out a technical mistake with the charging circuit.
The generator consists of a 4v motor connected to a compound gearbox with a crank-handle.
A compound gearbox is a gearbox with a "train of gears" (a set of gears) in which the gears are placed on shafts so that the "drive" goes from one shaft to the other and then back onto the first shaft. This saves space and makes a very compact gearbox. See photo below:



The Compound Gearbox

When the handle is turned fairly quickly, the output of the motor produces a maximum of 5.5v and has a current under short-circuit conditions of about 400mA.
You would think this is sufficient to charge a 3.6v cell, but it isn't.
The generator is connected to a bridge rectifier.
This has been done so the cell will charge, no matter which way the handle is turned.
But the bridge takes 1.2v from the generated voltage, leaving only 4v. When tested, the cell is receiving only 30mA, charging current!
The torch takes 45mA and the radio takes up to 90mA on full volume.
The instructions on the pack says 1 minute of winding will provide up to 30 minutes of operation.
This is clearly untrue and the only reason it is not immediately evident is due to the fact that the 3.6v cell is fully charged when the unit is sold.

How do we fix the problem?
There are two ways to solve the situation. The motor can be re-wound with more turns on each leg of the armature (it is a 3-pole motor) or a voltage-increasing circuit can be added.
We tried two different voltage-increasing circuits. An electrolytic to increase the voltage (in a charge-pump arrangement) and a flyback arrangement using a transistor and inductor.
Both circuits only allowed 50mA to be delivered to the cell and we considered we could improve on this by re-winding the armature.
From the photo below, you can see the armature is not fully filled by the original winding and this gives us an opportunity to add more turns. If the armature was already filled, we would have to remove the windings and use a finer gauge of wire so more turns could be put on each leg.
The "start" winding on each leg is soldered to the previous segment on the commutator and the end of the winding is soldered to the segment adjacent to the leg. The actual position of these segments depends on the position of the brushes so we cannot say they will always be aligned with a leg.
By simply removing the end of the winding and joining our new wire to it, we can add as many turns as possible. In our case 100 turns were added and the end of the wire was soldered to the commutator segment.

The disassembled motor (generator)

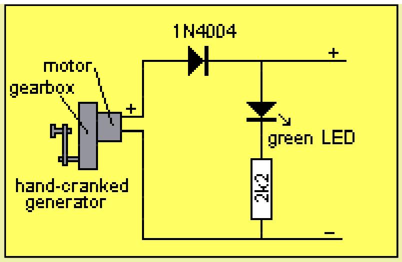
The following photo shows 100 turns added to each leg of the armature:

The 100 turns added to each leg

Only 100 turns could be added otherwise the turns touched the casing of the motor when the armature was replaced and this prevented it from turning.

When the motor was re-installed, the output voltage increased from 5.5v, to about 10v and the short-circuit current changed from about 400mA to 300mA.

A single diode was added to the positive line to prevent the Li-Ion cell from driving the motor in the opposite direction when the handle was not being turned and a green LED with 2k2 resistor shows when the generator is turning in the correct direction to charge the battery. The diagram below shows the circuit:



The diode and LED connected to the generator

The generator now delivered 100mA to the cell and this was an increase of more than 50mA over any of the other arrangements.
The main reason why only 100mA is delivered during the charging is due to the floating voltage generated by the Li Ion cell. It produces a voltage of 4.2v when charging.
After the cell is charged, and a load applied, the voltage gradually drops to 3.6v and this is why the cell is rated at 3.6v.

As a side issue, 3 Ni-cad cells produce a floating voltage of about 4.15v when being charged, so they pose the same problem.
This voltage detracts from the charging voltage plus the 0.7v drop across the diode and well as the output drop of the generator when under load, and the maximum charging current is about 100mA.

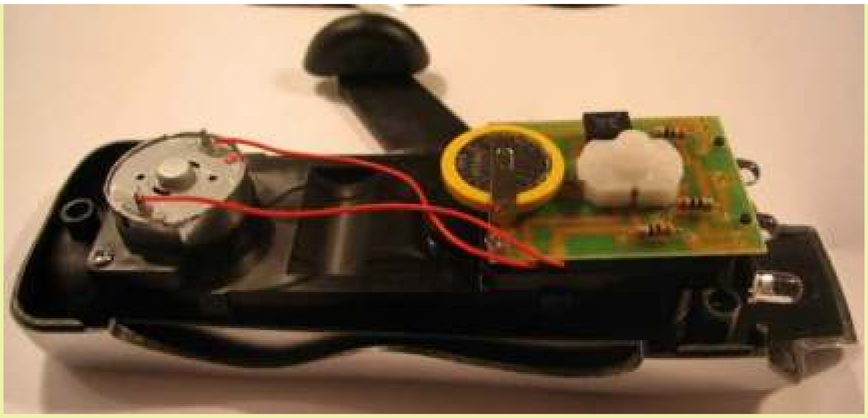
Overall, the modification was a success and if the manufacturer introduced this to his product, it would be a success. As it stands, the 25mA charging will never catch-up with the drain of the torch or radio.

The statement in the advert: 1 minute of winding will light the torch for more than 10 minutes, is entirely incorrect. But is takes a considerable amount of investigation to determine the facts.
Now you know.

While on the subject of a hand generator, you are possibly wondering how the output capability of a generator is determined.
Of course you can go through the complexities of mathematics but nothing beats experimentation. Try motors with different resistance armatures and magnet strengths and you will see how output voltage and current depends on the winding and magnet strength.
The no-load output voltage and short-circuit current do not tell you very much.
The no-load voltage just lets you know the maximum voltage and the short-circuit current lets you know the magnets are powerful.
As you add more turns to each leg of the armature, the length of each turn becomes longer and this adds extra resistance. The added resistance lowers the maximum current.
Three ways to increase the voltage:
Increase the number of turns. Increase the RPM and/or increase the strength of the field magnets.
We have achieved the absolute maximum performance from the motor in the produce under investigation. To get a greater output you need to go to a larger motor, with a larger armature. In other words, a larger pole face and this means a longer motor.

See our article on SOLAR CHARGER and SOLAR LIGHT.

Next we found a wind-up torch for the same cost as the Torch/Radio and we decided to buy it and determine the charging current.
The motor appeared to be identical to the Torch/Radio product, with the same gauge wire on the armature and approx the same number of turns.
The strength of the permanent magnet appeared to be the same but the voltage from the motor was about 10v on fast winding. The only conclusion was the slightly higher gear ratio, caused the motor to revolve at a higher RPM.



THE HAND-CRANKED TORCH - CHARGING CURRENT 175mA

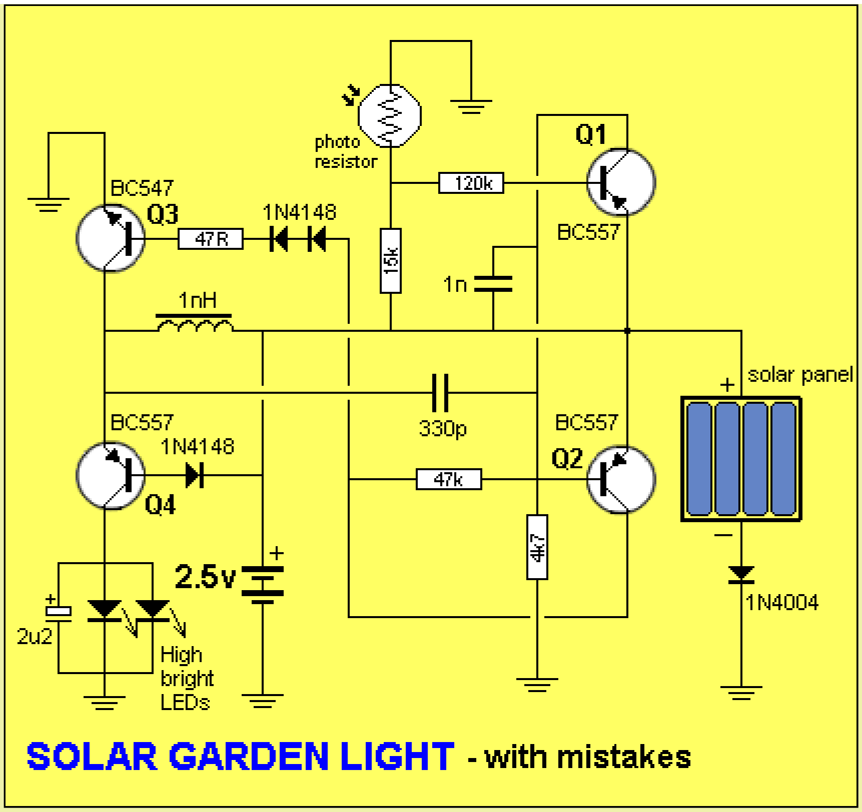
The photo below shows the gear-train (train of gears) and when the handle was turned fairly quickly, the output voltage rose to nearly 10v. But the most important point is the charging current was about 175mA, and the 3.6v Li Ion cell was identical to the Torch/Radio product.
The current consumption was 53mA for the 3 LEDs and the statement on the package: "Wind for 1 minute to get 10 minutes of illumination" was again, inaccurate. The true value would be about 3.5 minutes.
The components on the PC board are:
1. A bridge rectifier,
2. A push-push switch,
3. Three 30R resistors,
4. Three white LEDs
5. A 3.6v Li-Ion rechargeable Cell 450mAhr

THE TRAIN OF GEARS

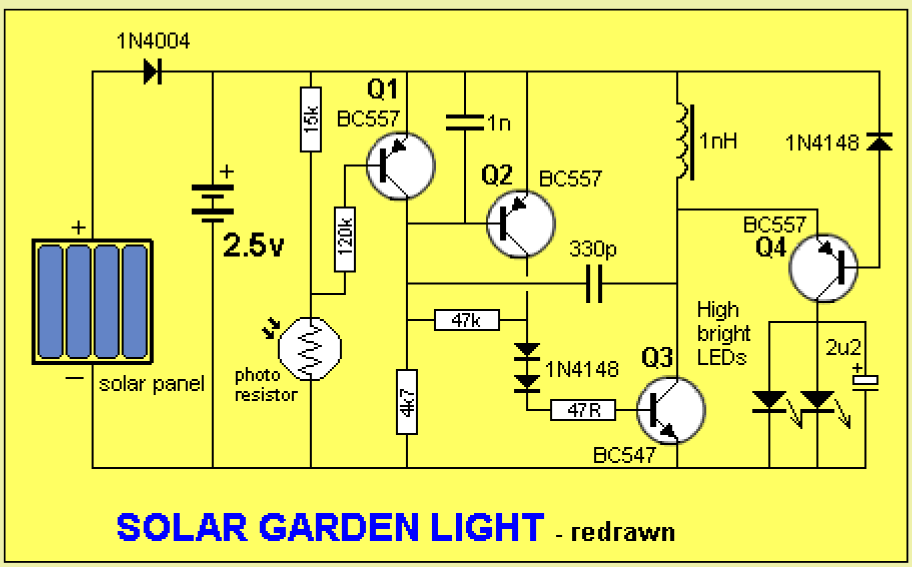
If you want to have a hand-cranked generator, this is the best choice of the two.

SOLAR GARDEN LIGHT

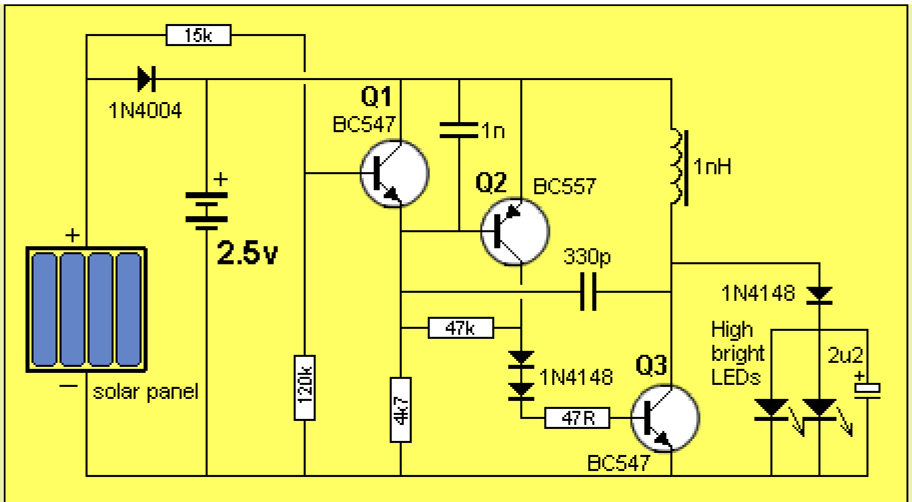
Now we have a circuit from a reader who asked how it worked and why the battery did not charge.
Here is the circuit as drawn by the reader:



There are a number of mistakes in the circuit above, and a generally very poor circuit design. But before we can work out how it works, we need to re-draw it:



The protection diode connected to the solar panel in the first diagram is around the wrong way. This is one of the reasons why the battery did not charge. The diode prevents leakage through the solar panel during dark conditions as the panel does not have a very high resistance in the reverse direction.
Q4 is not needed. It is designed to turn on when the voltage from the inductor is higher than rail voltage. But since the LEDs do not turn on until the voltage across them is 3.2v, the transistor is not needed. On testing the circuit, we found the LEDs turn on very slightly at 2.5v and a diode in place of the transistor turns them off.
Next, the two 1N4148 diodes and 47R resistor produce a very high current into the base of Q3.
This is a very bad design but since the whole circuit is badly designed, it is not possible to replace them at this stage.
Finally, the solar panel can be used to turn the circuit off when light is detected. The 15k resistor is connected to the panel and the photo resistor is removed.
This means some components can be removed from the circuit and this will be a saving, when you consider these garden lights are produced in 100,000's.
Our final circuit is shown below:

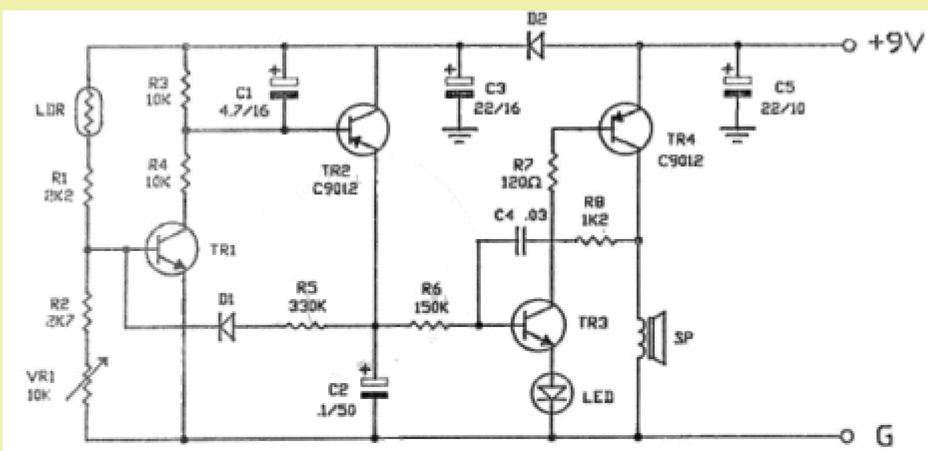


SOLAR GARDEN LIGHT - with mods

One of the bad features of the circuit is the impedance path through Q1 when it is turned on via the solar panel or photo cell, the 47k resistor, the two diodes, the 47R and the base-emitter junction of Q3.
The voltage drop on this line is 0.2v + 0.6v + 0.6v + 0.6v = 2v This leaves about 0.5v across the 47k and 47R. A very small current will flow into the base of Q3 , however the transistor is not actually turned off during daylight charging and if the supply voltage is increased, the circuit will consume a lot more current.
The purpose of the two diodes is to remove some of the supply voltage, to overcome this technical fault.

See two other Solar Garden Light circuits in our SOLAR GARDEN LIGHT article.

Here's a circuit from FUTURE KIT, that I don't understand.



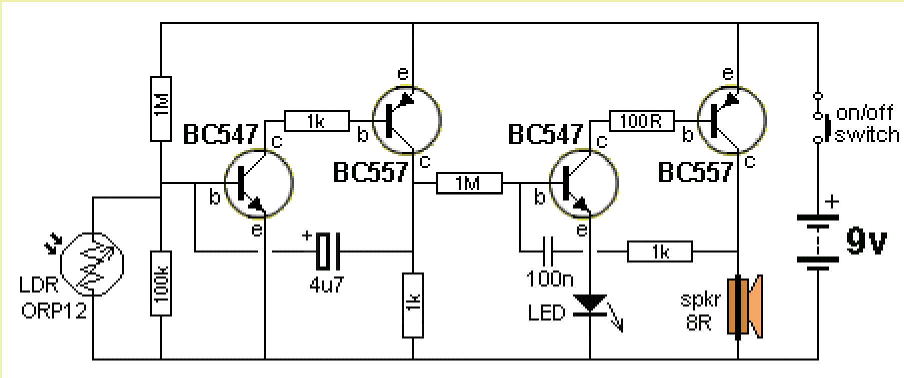
All the transistors supplied in the kit are NPN types, and yet the circuit diagram shows two NPN and two PNP. In fact one PNP is around the wrong way in the circuit. How this circuit ever worked is beyond me. But when I contacted the CEO of Future Kit, he was not interested. Many of his kits and circuits don't work, but then things don't have to work in Thailand.

What is the purpose of the first two transistors?
What is the purpose of C1, C3 and C5?
What is the purpose of Diode D1?
What is the purpose of Diode D2?
What is the purpose of R2?

When no light shines on the the LDR, the first transistor is turned off and the top 10k resistor pulls the second transistor to the positive rail as an emitter-follower and this charges the electrolytic in the emitter. This voltage is designed to turn on the two-transistor oscillator made up of transistors 3 and 4.
It also passes to the base of the first transistor but when you work out the voltage division of the 330k

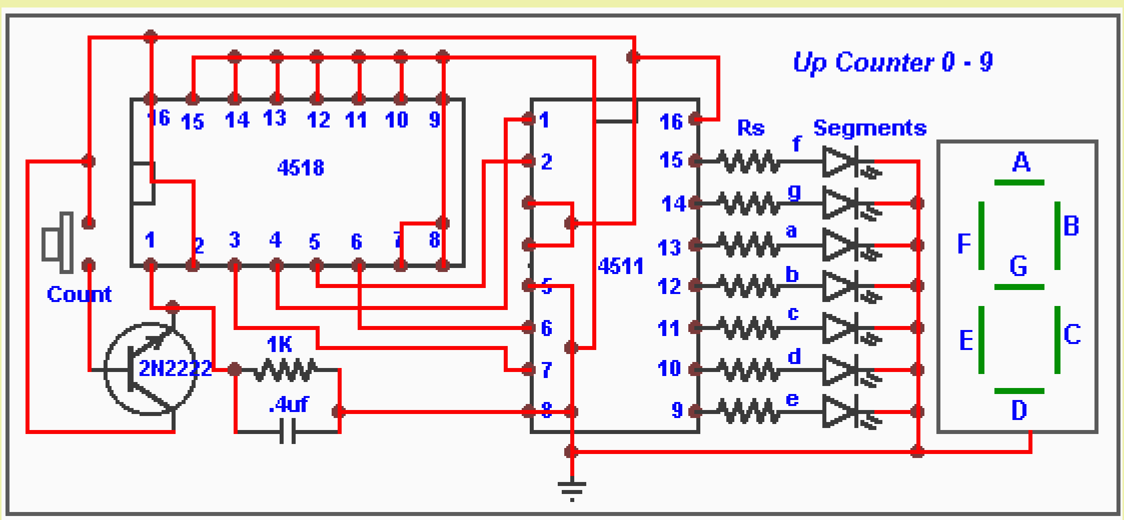
resistor and the two resistors on the base, you find the voltage on the base will never be higher than 0.315v and the transistor will never turn on.
It's amazing how things like this can get though a manufacturing stage and not get detected.

Here is the circuit the engineer was possibly trying to achieve:



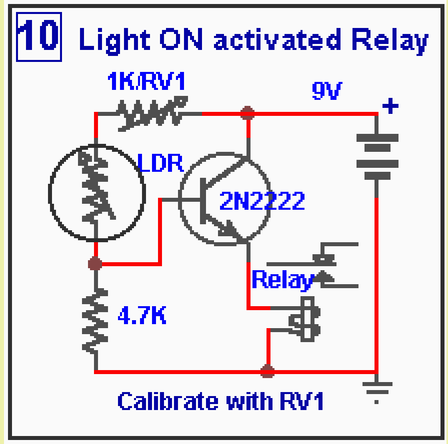
When the light does not shine on the LDR, the first transistor turns ON via the 1M resistor and produces a low-frequency oscillator that supplies voltage for the second oscillator, via the 1M, to produce a bee-beep-beep output. The 100k across the LDR needs to be adjusted for the light conditions the circuit will be operating under.

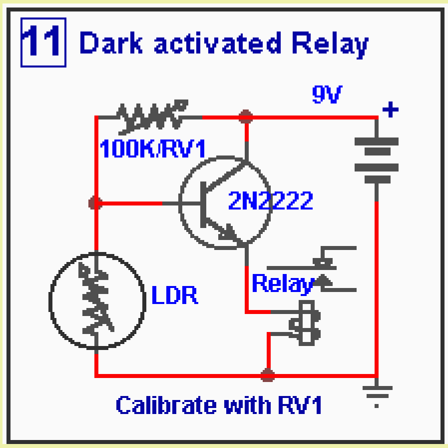
Next we have a simple 1-Digit Counter Circuit



The designer of the circuit claims the transistor connected to the switch is acting as a Schmitt Trigger. This is simply not true.
In fact the transistor is making the situation 100 times WORSE. It is increasing the input impedance of the "count circuit" by a factor equal to the gain of the transistor and this can be 100 - 300 times. This is the opposite to what we want and although additions like this might look fantastic, you must check what is happening before adding them to a circuit.

Here are two more circuits that obviously have not been tried:

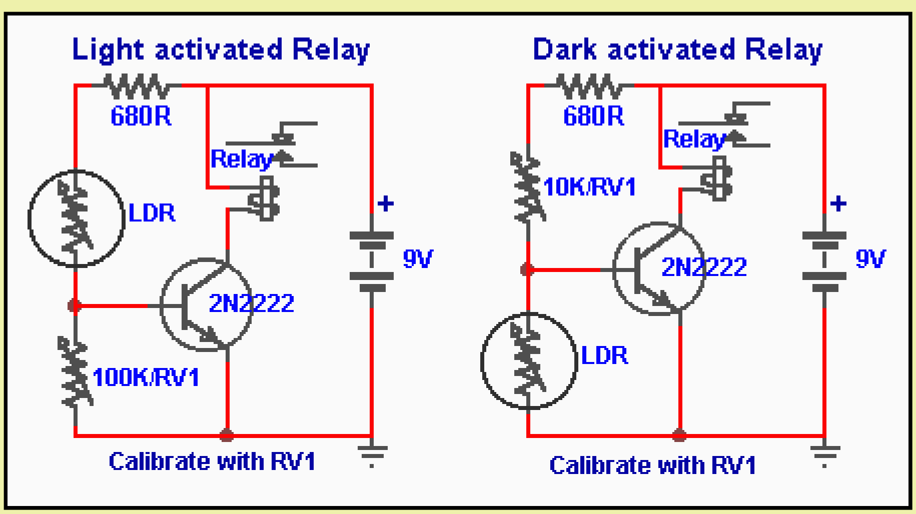




The problem with both circuits is approximately the same. Both transistors are emitter-followers and in circuit number 10 the emitter will not rise above 6.6v as the LDR will not have a resistance below 200 ohms and the base will see a maximum of 7.2v due to the voltage division of the 1k, LDR and 4k7 resistors. The emitter will be 0.6v below this and the result will be so poor that many relays will not pull in.

Circuit number 11 has a similar fault. An LDR will have a dark resistance of about 1M and this will produce a voltage divider of 8v on the base. The emitter will be 7.6v and if the transistor has a gain of about 200 the maximum current delivered by the emitter will be 15.2mA so any relay requiring 20mA or more will be under-fed.

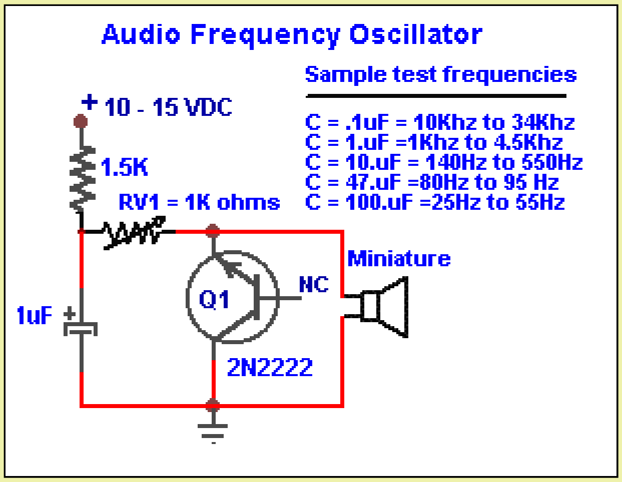
Both circuits above are totally unreliable and the following should be used:



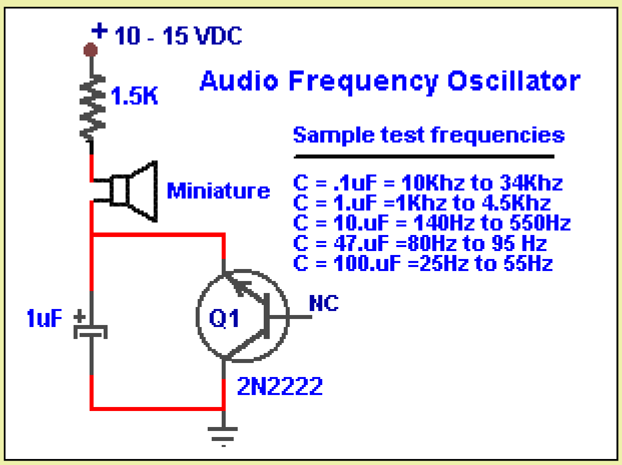
Everyone gets so upset when I point out a mistake on their website or in their book.
But, as I say in all my writings; to be an electronics engineer, you must be able to "see" a circuit working to be able to use it, modify it, or fix it.
That's the level I am bringing everyone up to. VISUALISATION.

It's pointless presenting circuits that have not been tried. The attitude: "It'll work!" will bring you undone. Try it. It may not work or you may be able to improve it.
See out latest ebook 200 Transistor Circuits for partA with 100 interesting circuits using transistors.

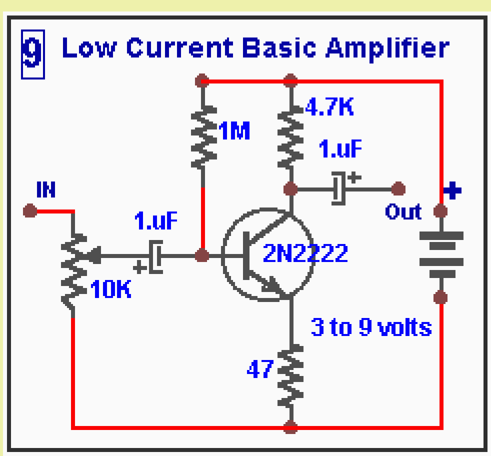
Another circuit that does not work:



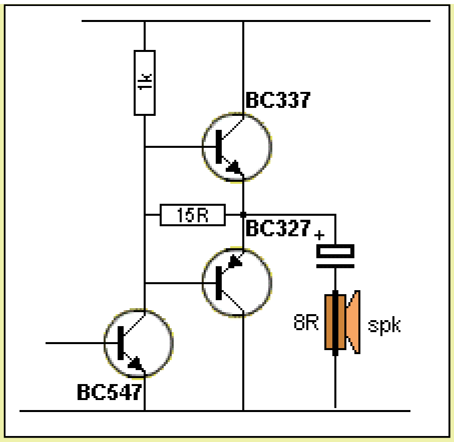
The only alternative is the following. The sound from the speaker will be very low:



Here is a another mistake. The designer added the 47R as a current limiting resistor. But how much current will a 47R limit in a low-current circuit? The 47R has no effect on the performance of the stage and can be omitted.
When designing a circuit, look at each component and ask: "Is it necessary?" You will find many circuits in this discussion can be simplified - and that's the mark of a clever designer.



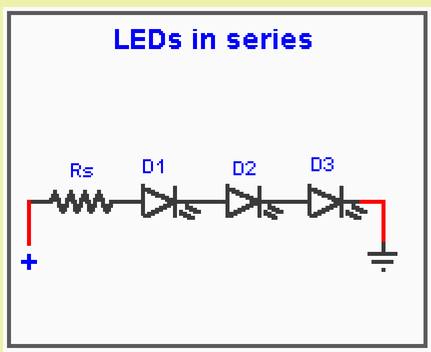
On the other hand, here is a circuit from **The Transistor Amplifier** article, where the 15R resistor appears to be unnecessary:



But it transfers the low-level signals directly to the speaker. As the signal-level increases, the output transistors come into operation. This arrangement removes cross-over distortion and uses less parts.

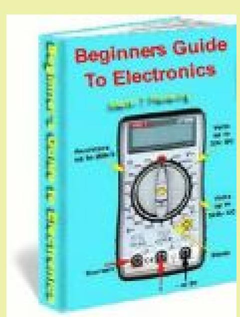
More outdated information . . the writer of an article states:

The series LED connection circuit shown below can be used but I strongly do not recommend it. Regardless of good current calculation and voltage regulation one or more LEDs are bound to fail as an open circuit which can be a real pain trouble-shooting to find and replace the bad LEDs . If one or more LEDs fail as a short than other LEDs in the string may well be destroyed by excess current load, an expensive proposition.



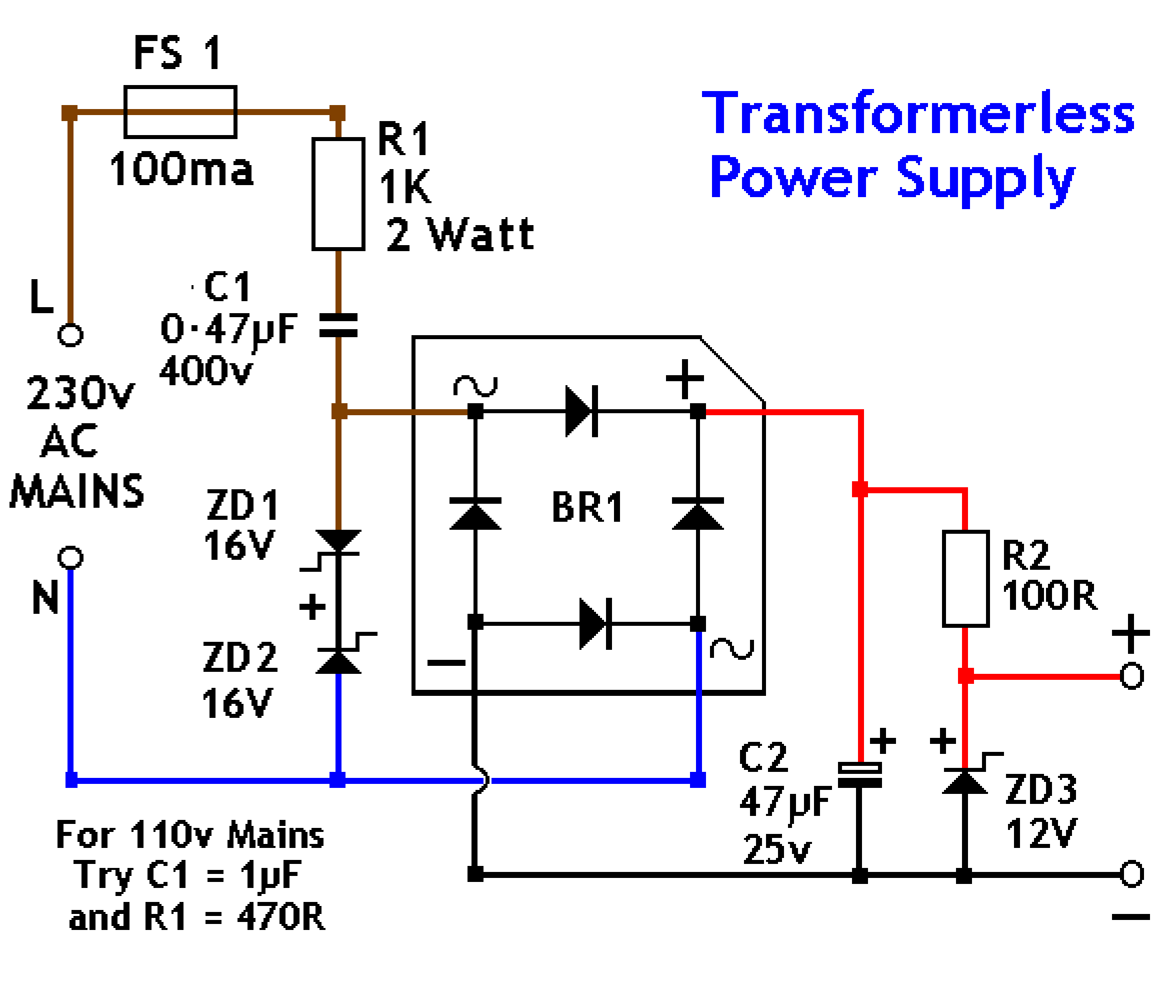
10 million cars, trucks and street lights now have series LEDs and the failure rate is so low that they are becoming normal. The suggestion about series LEDs being unreliable is totally unfounded. LEDs have an approximate life of 50,000 hours and this is far beyond the life of a globe.

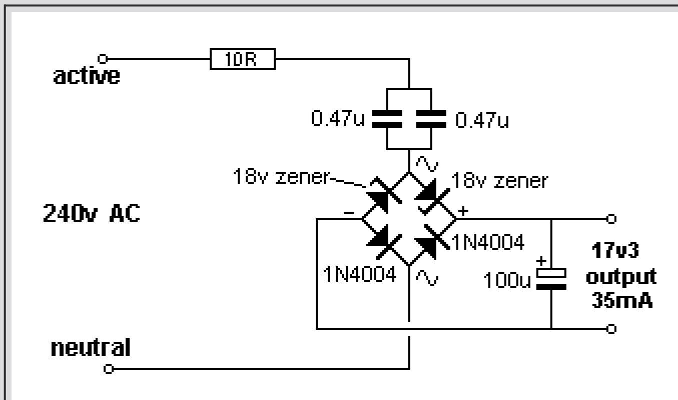
The original version of this eBook had so many technical mistakes, I had to completely re-write the text.



You can see the corrected text HERE.

Here's a circuit that just needed a "design-consideration."
When you design a circuit, ask yourself the question: "Can the circuit be simplified?"
In the following design, the answer is: "Yes."
The two zeners and 4 diodes in the bridge can be combined with a saving of two components.
See the diagram below for the final design.





TRANSFORMERLESS POWER SUPPLY

This clever design uses 4 diodes in a bridge to produce a fixed voltage power supply capable of supplying 35mA.
All diodes (every type of diode) are zener diodes. They all break down at a particular voltage. The fact is, a power diode breaks down at 100v or 400v and its zener characteristic is not useful.
But if we put 2 zener diodes in a bridge with two ordinary power diodes, the bridge will break-down at the voltage of the zener. This is what we have done. If we use 18v zeners, the output will be 18v - 0.6v - 17.3v and the output must be kept away from the active and neutral input lines. The current is limited by the value of the X2 capacitor and this is 7mA for each 100n when in full-wave (as per this circuit). We have 10 x 100n = 1u capacitance. Theoretically the circuit will supply 70mA but we found it will only deliver 35mA before the output drops. The capacitor should comply with X1 or X2 class. The 10R is a safety-fuse resistor.
The problem with this power supply is the "live" nature of the negative rail. When the power supply is connected as shown, the negative rail is 0.7v above neutral. If the mains is reversed, the negative rail is 340v (peak) above neutral and this will kill you as the current will flow through the diode and be lethal. You need to touch the negative rail (or the positive rail) and any earthed device such as a toaster to get killed. The only solution is the project being powered must be totally enclosed in a box with no outputs.

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SPOT THE MISTAKES!

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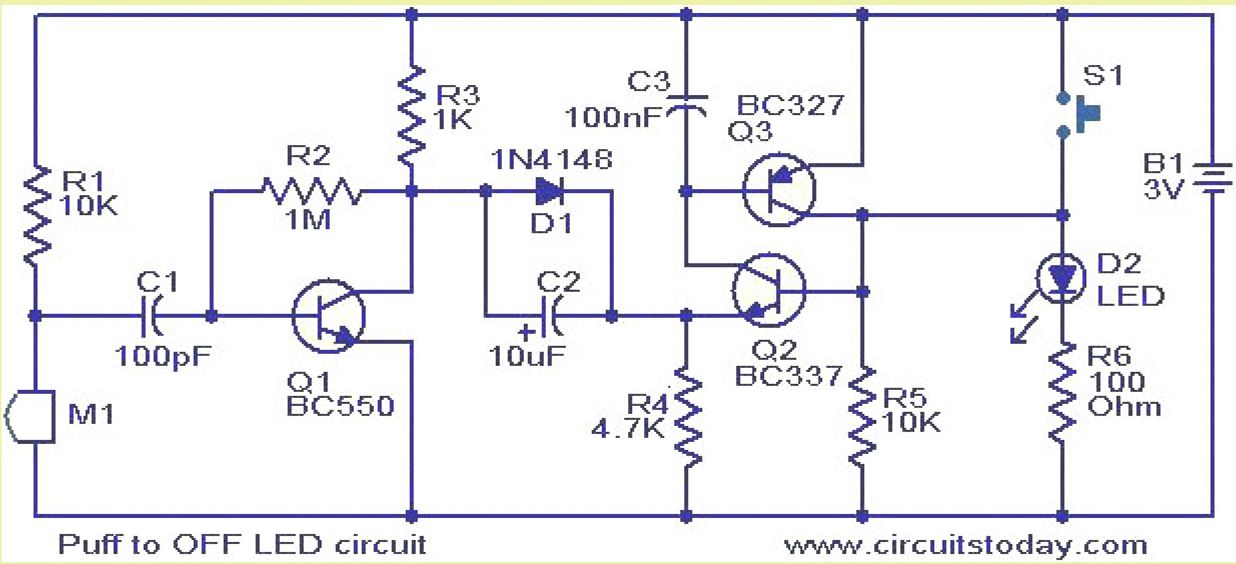
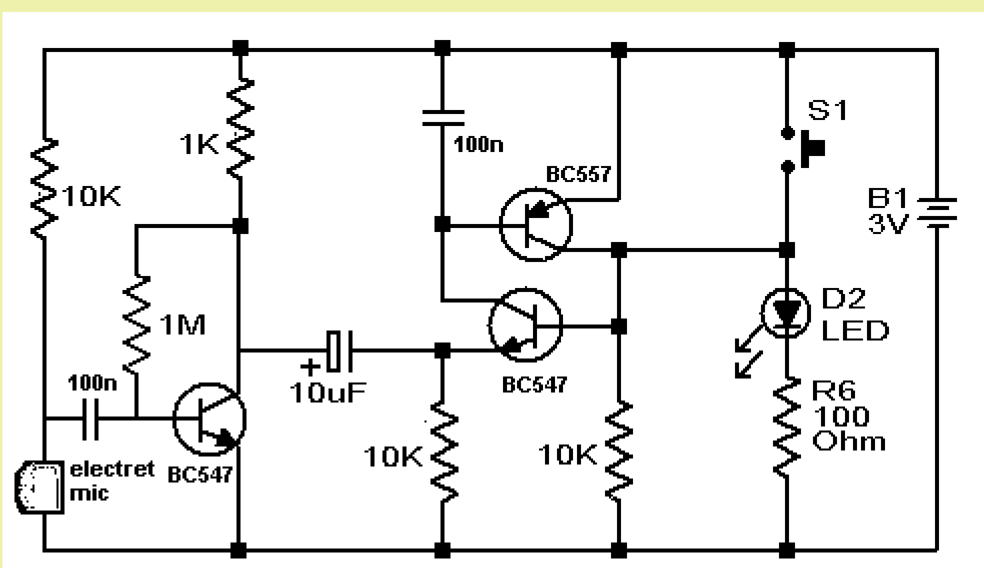
Here's a circuit with a slight fault:

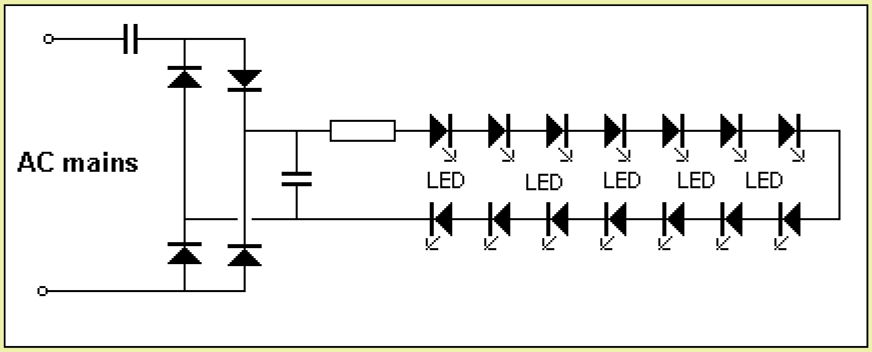


The 100p between the microphone and base of the first transistor will not pass any waveform. It needs to be 100n.
It's obvious the circuit has never been tested.
The only other change is the removal of the diode. It changes the flickering effect and makes the circuit more realistic.
We call this circuit a "fun" circuit. Here is the corrected circuit:



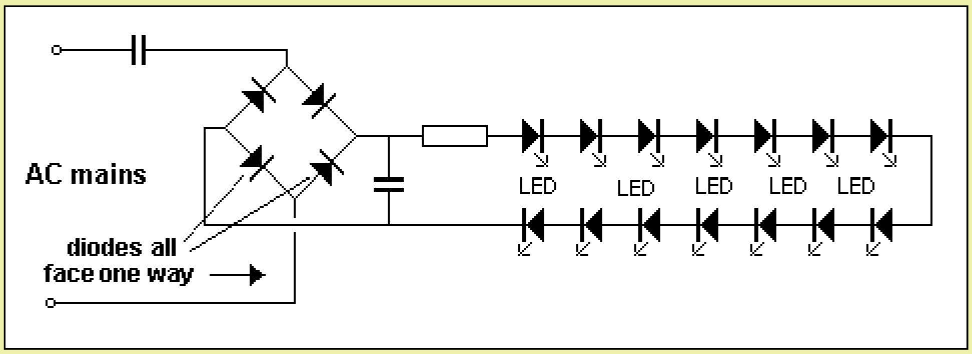
See more VOX circuits in The Transistor Amplifier eBook.

The next example is only a simple mistake but it emphases the fact that you should draw things in a way that they are instantly recognizable. The following has a mistake and no-one in the electronics forum picked it up.

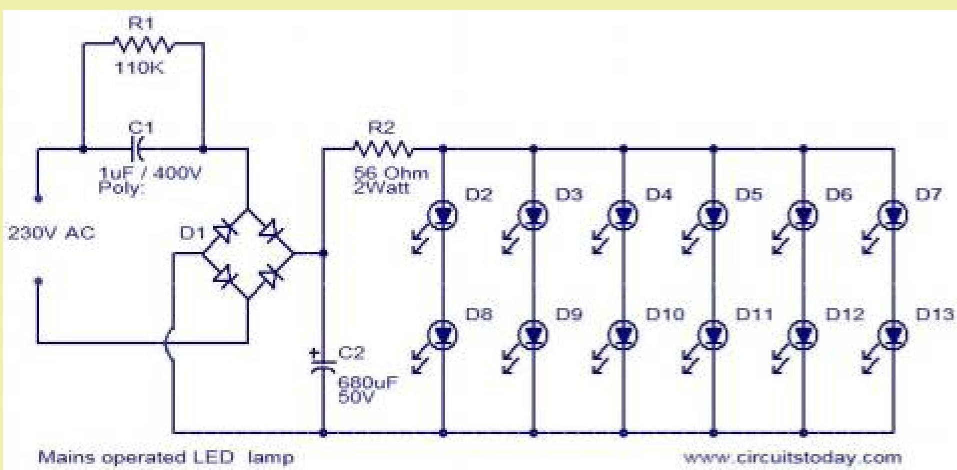


One diode in the bridge is around the wrong way.

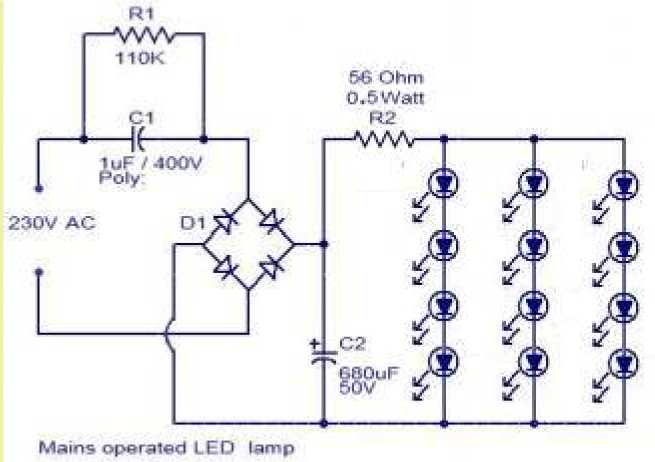
The bridge should be drawn as follows:



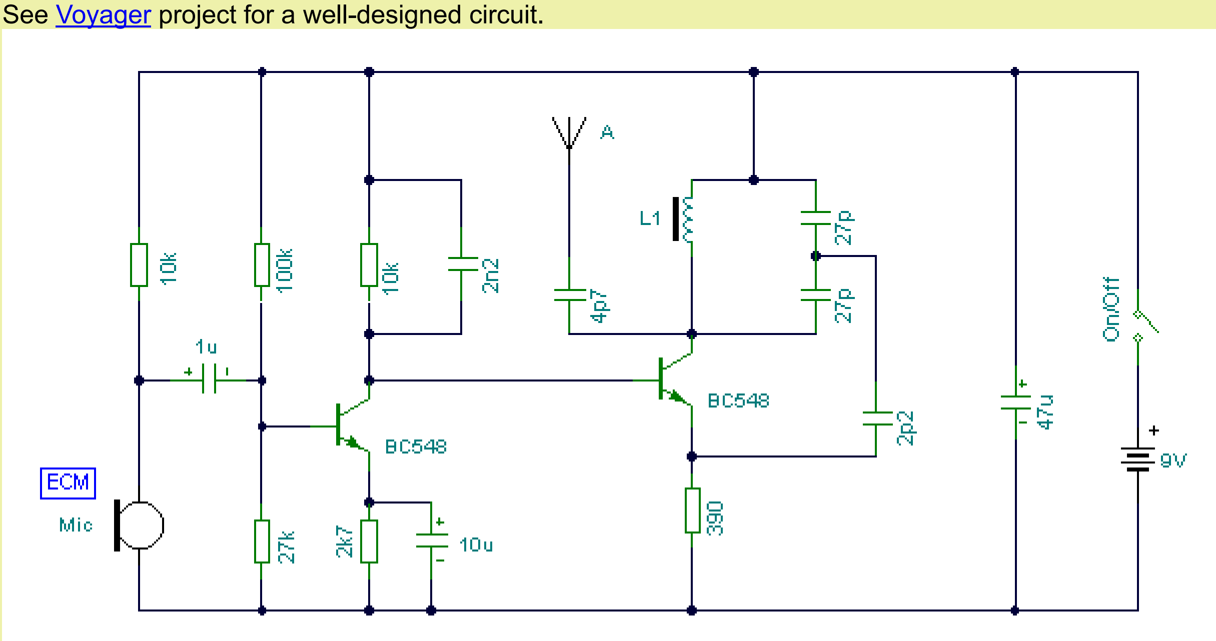
Another circuit from circuitstoday.com:



The 1u capacitor will only deliver about 60 - 70mA and a white LED needs about 17 - 20mA for good brightness. By simply re-arranging the LEDs, the circuit will work much better:



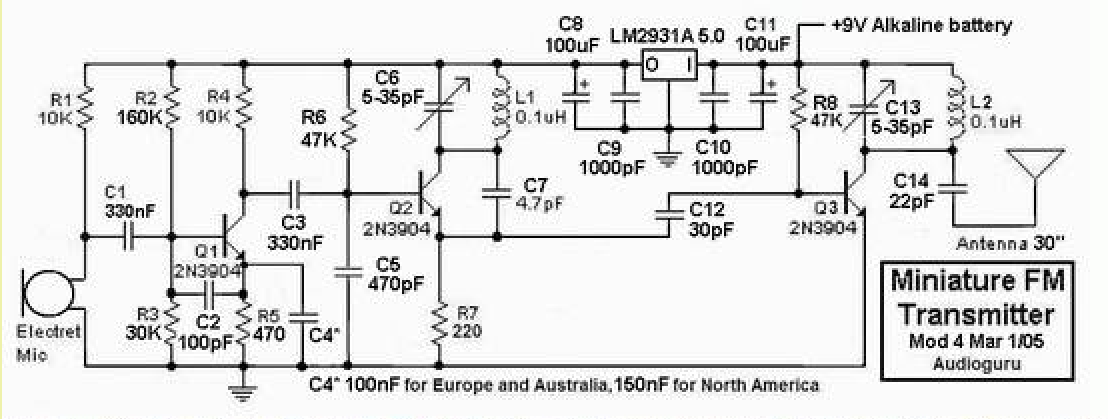
Here is a circuit of a 2-Transistor FM transmitter. It has a number of mistakes in the design.
See [Voyager] project for a well-designed circuit.

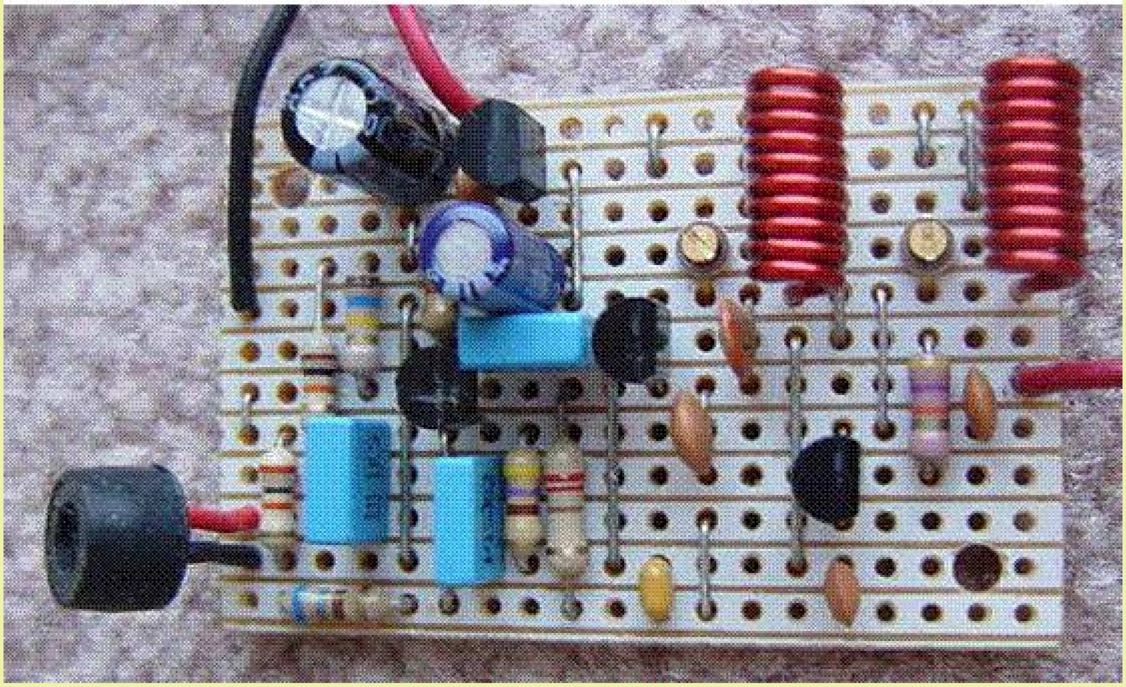


The load resistance for the microphone is too low. It will cause the microphone to have a very high gain and create a self-oscillating front-end.
The 1u coupling capacitor does not need to be higher than 22n. A ceramic is quite suitable for this.
The two stages should not be direct coupled. The oscillator stage should be self-biased so that it creates its own biasing. A "forced bias" does not allow the transistor to operate in its best set of parameters.
The tapping between the two 27p's gives a very small signal to the emitter. The 2p2 should tap off the collector. The parallel 27p's gives a value of 13p, whereas the capacitance across the inductor should be about 47p for the best "Q" for the tank circuit. No value has been given for L1. It should be 5 turns 0.25mm wire 3mm dia.
The 47u across the battery is not needed. It should be replaced with 22n to tighten up the rails for the 100MHz oscillator.

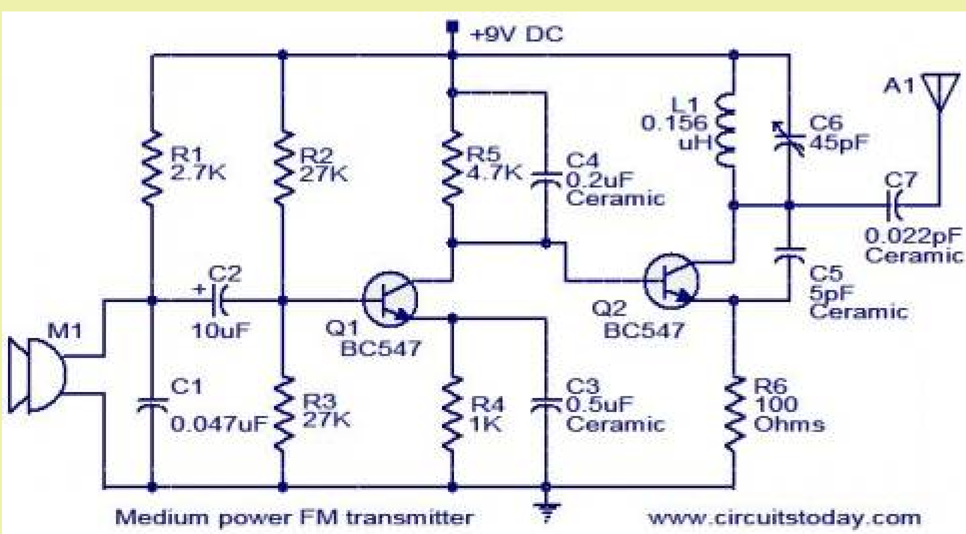
Next we have an FM transmitter that looks to be well-designed. Apart from the complex circuit, there are a number of fundamentally incorrect features that make the circuit unreliable.
And the layout is one of the worst I have seen for an FM transmitter.
This type of circuit should NEVER be laid out on strip-board and any type of board that has extra conductive lines as they create "wires" that radiate signal and they can be so effective that all the signal is radiated and none is retained to keep the oscillator in a state of oscillation. That's why this type of layout can result in non-operation.
The first item we will look at is the "Q" of the tank circuit.
This is a factor known as "Quality" and comes from the fact that an inductor will produce a voltage (of opposite polarity) that can be many times higher than the voltage applied to it.
And that's what a circuit like this FM transmitter does. The voltage produced by the capacitor and parallel

inductor on the collector, will produce a voltage many times higher than the 5v on the rail.
These two components are called a TANK CIRCUIT and to get them to produce a high voltage, the energy stored (and released) by the capacitor must be equal to that of the inductor. The two work like tipping water from one jug to another of the same size and back again. If one jug is smaller, we only get the energy from the smaller jug.
In this case the 5-35p air trimmer will be set at about 20p for 90MHz while the energy stored in the 10 turn coil will be twice that needed. The 10 turn coil should be reduced to 5 turns and the capacitor should be increased to 39p - 47p. This will give the circuit a higher "Q."
With a low Q, the energy through C7 (4p7) will be very small.
We don't know how or where the tracks are cut on the "strip-board" but you can see some of the track will connect to the end of the 4p7 that goes to the emitter.
This track acts like a "transmission line" and since it is very wide, it will have a high value of radiation.
This means a certain amount of the energy delivered by the 4p7 will be lost to the surroundings and any handling of the project will cause drifting or it could come to a point where the oscillator fails when handled.
In addition, some of the energy delivered by the 4p7 is being lost via the 30p coupling capacitor and the circuit may fail to work.
The circuit may be successful as the oscillator transistor is being heavily driven via the 220R in the emitter.
This may overcome the short-falls in the other design-concepts, but the 30p "take-off" should be connected to the collector of the oscillator stage as it will transfer a lot more energy.
High frequency circuits like this need to be designed so the power rails are "tight." This not only means electrical and electronic "tightness" but also physical tightness.
The 1n across the power rails for the output stage is insufficient to give good tightness (it should be 22n) and the placement of the components on the board is far too spread-out.
This makes the project very susceptible to handling and drifting.
Since the output transistor is a buffer, the 22p on the antenna is not needed and simply reduces the range.
The 30 inch antenna will give a very small range.
The 10k resistor on the electret mic is too low for our high-sensitivity microphones. It should be 47k for 5v rail.
The 100u electrolytic across the battery is totally unnecessary as the current consumption is only a few milliamp. In addition, the 100u on the output of the regulator needs to be only 1u to 10u.
Overall, I consider the circuit is taking 2 - 3 times more current than it needs.
Our 9v Voyager circuit consumes 7-10mA for 800metre range. This circuit will consume more than 25mA.
I have just been informed that this circuit consumes about 54mA. Most of this current flows though the 2N3904 transistor.
This type of transistor can only handle about 10mA to 15mA when operating at 100MHz and any current above this simply swamps the transistor and is not converted to an output signal. The transistor simply heats-up and wastes the energy.
One final point. The air trimmer should be in parallel with a capacitor (39p) so the trimmer is only adjusting a small amount of the total capacitance. This makes it easier to tune across the band and set the frequency.





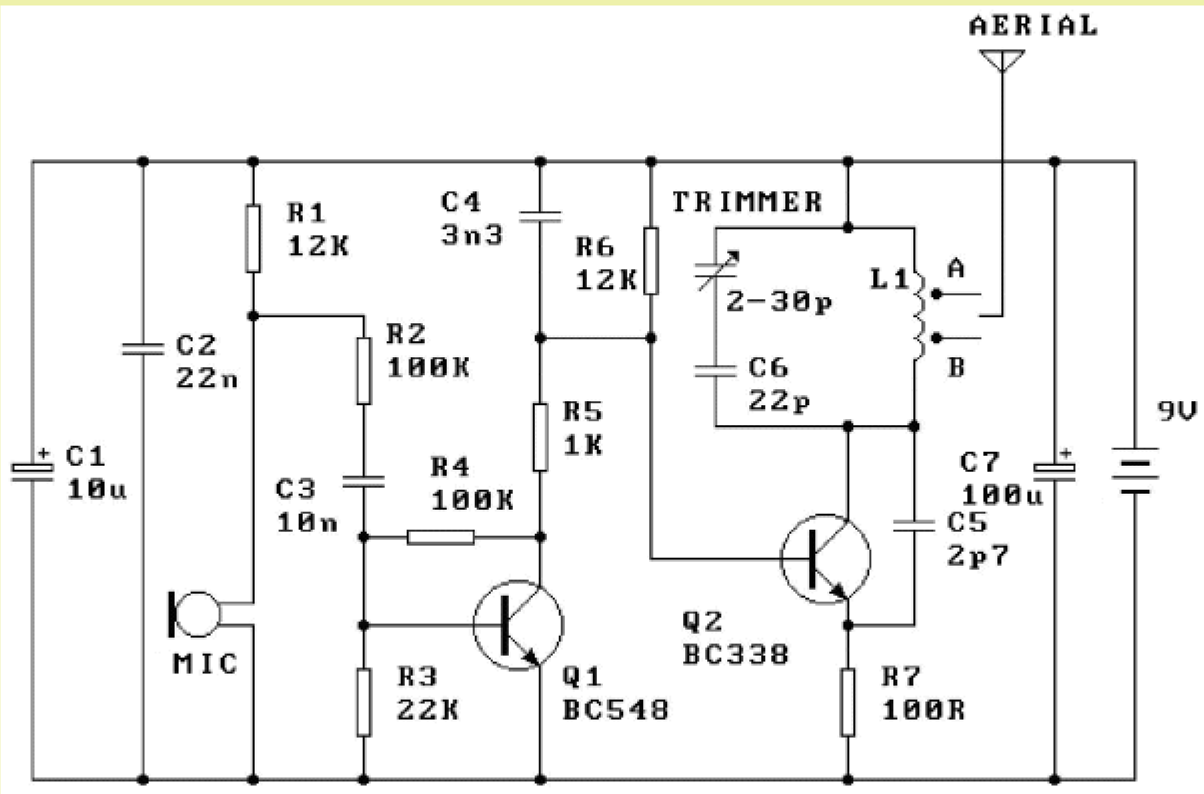
Here is another circuit from CircuitsToday:



Again, it's another circuit that looks to be ok.
But you have to go deeper into the designed to see the faults.
The Microphone symbol shows the old-fashioned mic for a telephone.
It should be an electret mic symbol:

The 2k7 load for the microphone is too low. It will cause motor-boating. The load should be at least 47k.
The 47n across the microphone is not needed if the mic is biased correctly.
The 10u coupling to the base of the first transistor can be 22n.
The oscillator should be self-biased. This allows it to operate freely and maintain better stability.
The 100R in the emitter should be 560R as the BC547 can only handle a very low current at high frequency.
The inductor should be specified as 5 turns of 0.5mm wire 3.5mm dia coil. The supply should be "decoupled" via a 22n capacitor.
The 200n capacitor on the base of the oscillator transistor is too high. It should be 1n.
The 22n on the antenna is not needed.

While on the topic of FM transmitters, here's an FM transmitter with a number of mistakes.
It was designed by Harry Lythall of Sweden and I am surprised at the number of mistakes.

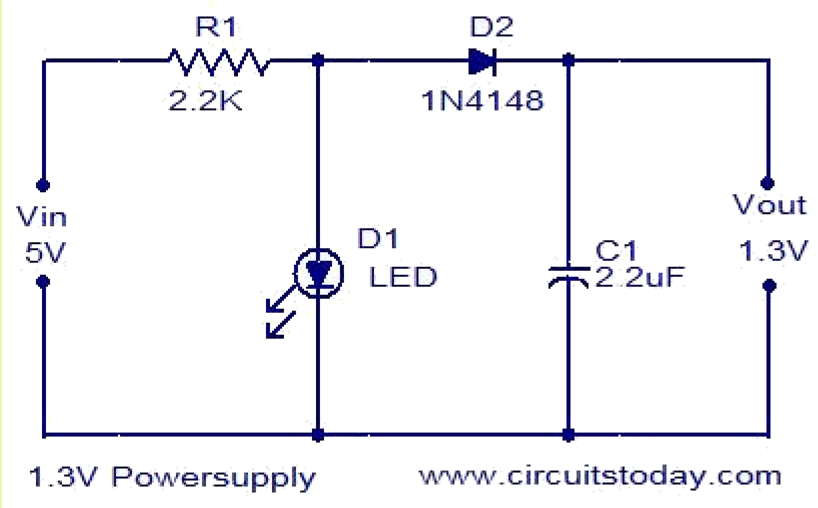


9V TRANSMITTER

1. You don't need 10u and 100u electrolytics. You don't need any electrolytics AT ALL.
2. The microphone is heavily turned on via the 12k resistor then its output is attenuated by the 100k resistor. 12k is too low and will overload the microphone considerably.
3. The oscillator is DC biased via the first transistor and this is not a good arrangement. The oscillator should be "self biased."
4. The trimmer capacitor should be in parallel with the 22p so that it has a small effect on adjusting the frequency.
5. R5 will have almost no effect on the operation of the circuit and is not needed.
6. BC338 is a power transistor and is not designed for 100MHz operation.
7. The 22n should be across the battery (and not at the audio end of the circuit) because the function of the 22n is to keep the power rails "tight" at the oscillator end.
8. The coil is etched on the PC board and this type of coil has a very low "Q." The circuit will have a very low output.

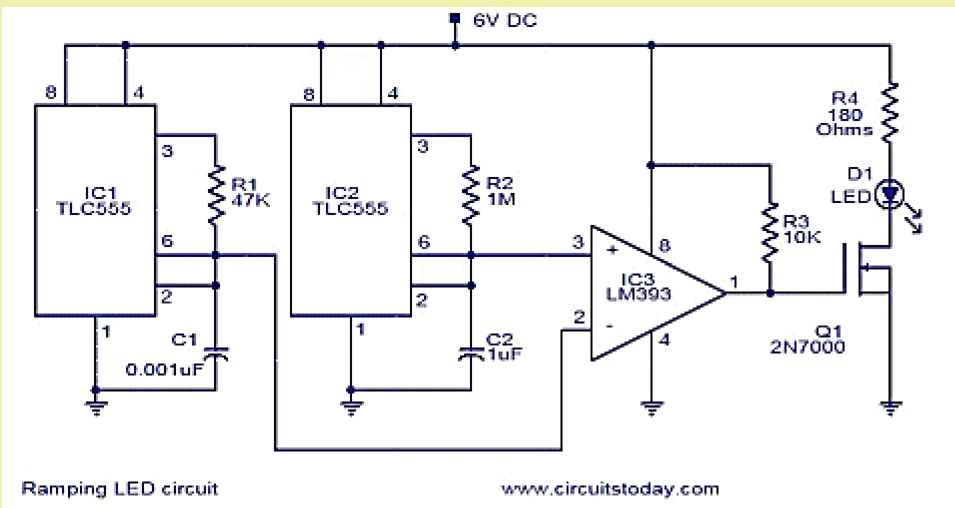
Overall the circuit is a very poor design and is not worth building.

Here's another absurd circuit from **Circuits Today**:

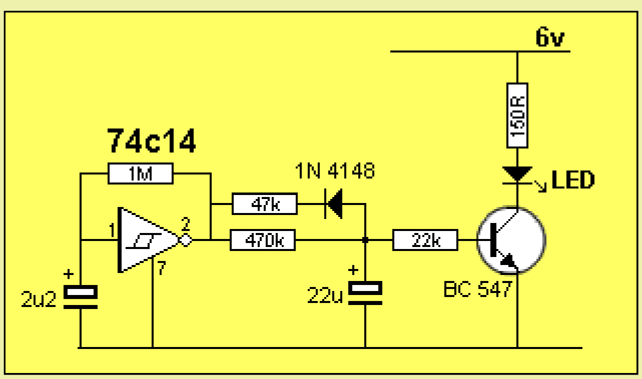


The designer of the circuit claims you will be able to get current from the output "just like a 1.3v button cell."
The LED will take 1.3mA. How bright will it be????
But look at the 2k2 resistor. For every milliamp that flows though the 2k2, two point two volts will be dropped across the resistor. If 2mA flows, the voltage at the top of the LED will be 5v - 4.4v = 0.6v. If you try to draw 3mA, the voltage will be 5v - 6.6v = ?????? Obviously you cannot draw 3mA.
This is a simple lesson. Before you draw any circuit and put it out for others to see, TEST IT.
Even the simplest circuit can be incorrect.
Circuits Today is an Indian site and they have not replied to any of my comments. They don't even have an email address. That's the wonderful part of the web. You can find all sorts of material and you have to sift through everything to work out if it is correct.

Here's an over-designed circuit from **Circuits Today**:

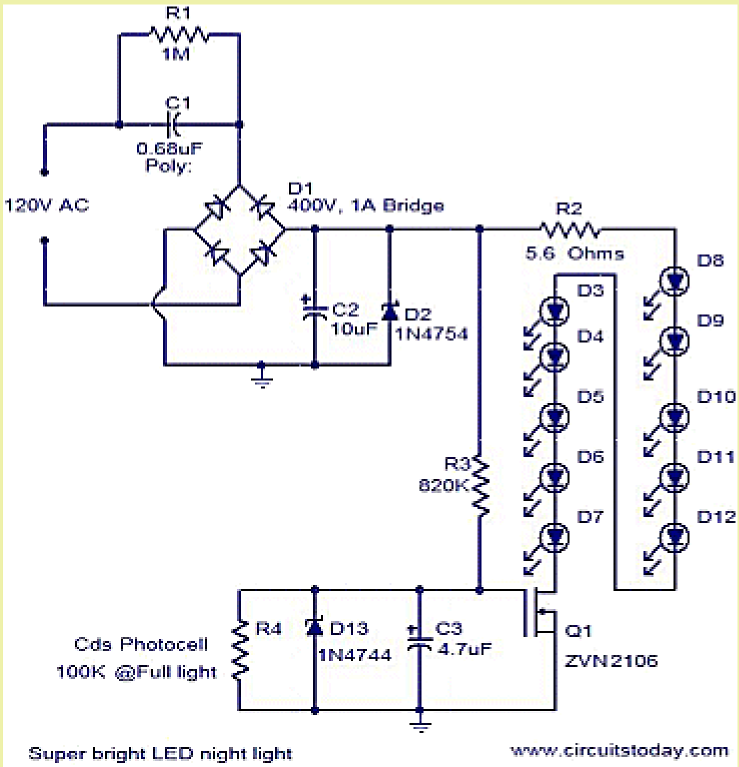


The circuit above can be replaced with the following circuit:

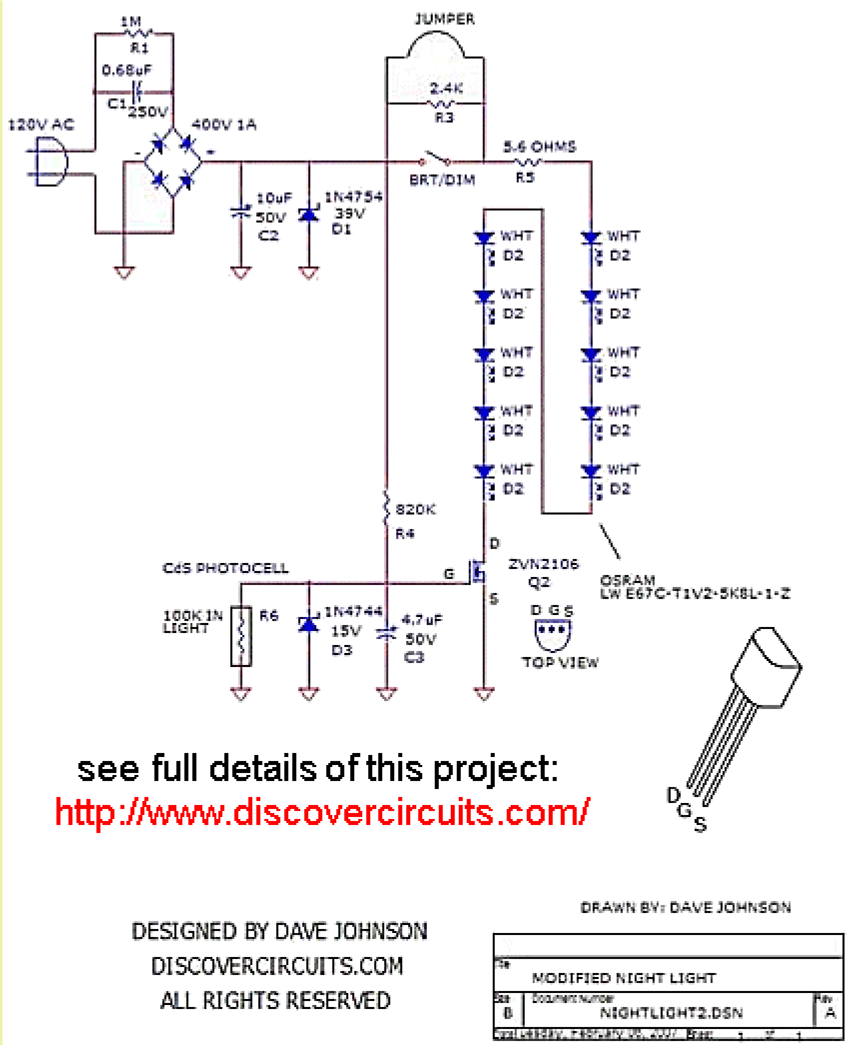


The circuit gradually fades the LED ON and OFF.
Before designing a circuit, DO YOUR HOMEWORK. Look on the web and see how other's have tackled the task you are working on.
There's always a simpler, cheaper, way to do things and that's why you need to research things before starting. The 74C14 has six Schmitt inverters and we have used only one. The 22u charges via the 470k and discharges via the 47k. This creates a gradual on/off effect that has equal timing. The unequal charge / discharge rates compensate for the non-linear surrounding components.

Here's another circuit from **Circuits Today**: (every circuit they issue each week has a fault!)

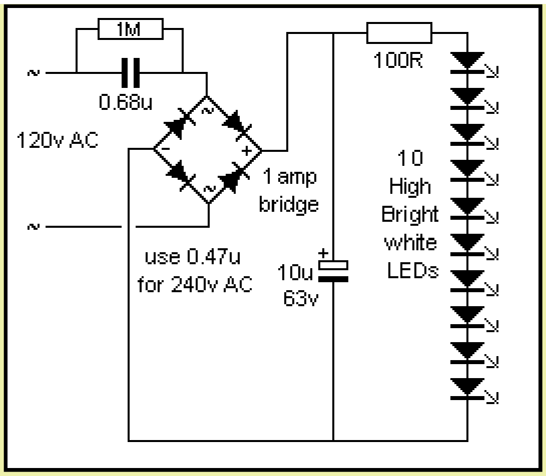


Here's the original circuit:

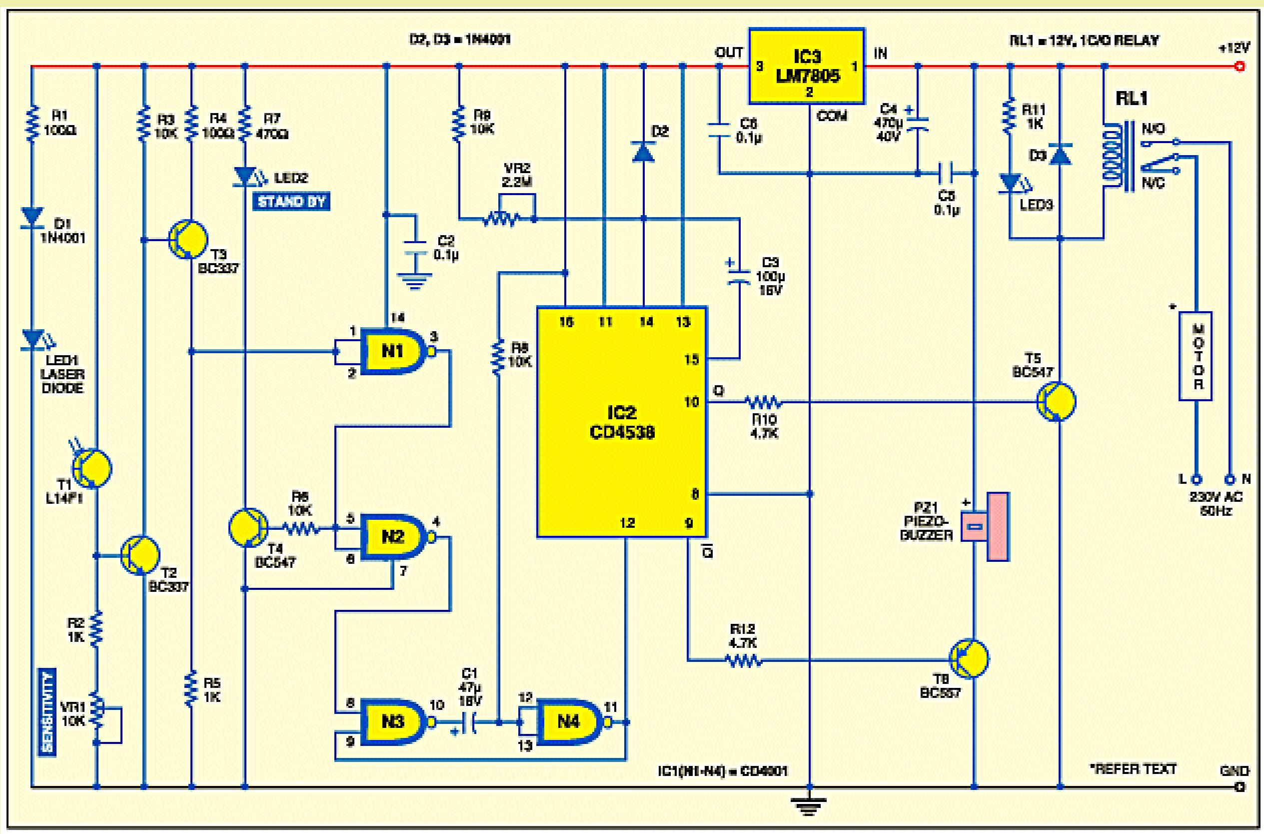


The bridge in the **Circuits Today** circuit is incorrect. The zener values are not identified with the voltage rating and the 5R6 will have no effect on protecting the LEDs.
The comment about the CdS photocell needs more explanation. The author states the circuit will turn off when the light falling on the photo cell causes the resistance of the cell to drop to 100k. At this point in time, the LEDs are illuminated and the voltage from the rectifier is approx 36v - due to the voltage drop across the 10 LEDs.
This voltage is prevented from rising above 15v via the zener across the photocell.
When the resistance of the photocell falls to 100k, the only two components to consider are the 820k and 100k photocell, in series. This will produce a voltage at the mid-point of 3.9v This is too high to turn off the DMOS FET ZVN 2106. You will need to either add a resistor across the photocell or allow the brightness of the room to increase.
The current taken by the circuit is the same when the LEDs are not illuminated (the current is taken by the 39v zener) so the addition of the DMOS FET and zener diodes are not really needed.

Here's what is needed:



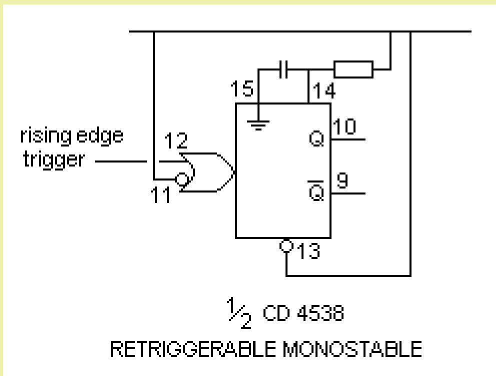
Here is a project from **Electronics For You**, an Indian publication. The circuit is over-designed. See if you can work out what the circuit is trying to do and see if the simplified circuit does the same job:



This automatic door opener can be made using readily available components. The electromagnetic relay at the output of this gadget can be used to control the DC/AC door-opener motor/solenoid of an electromechanical door opener assembly, with slight intervention in its electrical wiring.
A laser diode (LED1) is used here as the light transmitter. Alternatively, you can use any available laser pointer. The combination of resistor R1 and diode Dl protects the laser diode from over-current flow. By varying multi-turn trim-pot VR1, you can adjust the sensitivity. (Note that ambient light reflections may slightly degrade the performance of this unit.)
Initially, when the laser beam is falling on photo-transistor T1, it conducts to reverse-bias transistor T3 and the input to the first gate (N1) of IC1 (CD4001) is low. The high output at pin 3 of gate N1 forward biases the LED-driver transistor (T4) and the green standby LED (LED2) lights up continuously. The rest of the circuit remains in standby state.
When someone interrupts the laser beam, photo-transistor T1 stops conducting and transistor T3 becomes forward-biased. This makes the output of gate N1 go low. Thus LED-driver transistor T4 becomes reverse-biased and LED2 stops glowing. At the same time, the low output of gate N1 makes the output of N2 high. Instantly, this high level at pin 4 of gate N2 triggers the monostable multivibrator built around the remaining

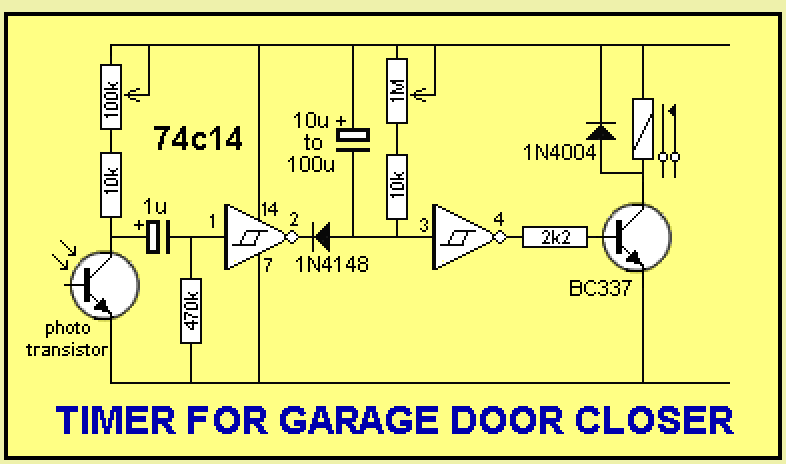
two gates of IC1 (N3 and N4). Values of resistor R8 and capacitor C1 determine the time period of the monostable.
The second monostable built around IC2 (CD4538) is enabled by the high-going pulse at its input pin12 through the output of gate N4 of the first monostable when the laser beam is interrupted. As a result, relay RL1 energises and the door-opener motor starts operating. LED3 glows to indicate that the door-opener motor is getting the supply. At the same time, piezo-buzzer PZ1 sounds an alert. Transistor T5, whose base is connected to Q output (pin 10) of IC2, is used for driving the relay. Transistor T6, whose base is connected to $\overline{Q}$ output of IC2, is used for driving the intermittent piezo-buzzer. 'On' time of relay RL1 can be adjusted by varying trim-pot VR2. Resistor R9, variable resistor VR2 and capacitor C3 decide the time period of the second monostable and through it on time of RL1.
The circuit works off 12V DC power supply. Assemble it on a general-purpose PCB. After construction, mount the laser diode and the phototransistor on opposite sides of the doorframe and align them such that the light beam from the laser diode falls on the phototransistor directly. The motor connected to the pole of relay contacts is the one used in electromechanical door-opener assembly. If you want to use a DC motor, replace mains AC connection with a DC power supply.

The first thing you have to work out is the operation of the CD 4538:



It is wired as a retriggerable monostable and this means when Q goes HIGH and $\overline{Q}$ goes LOW, both the relay and piezo are energised.
The timing of the output is controlled by the 10k stopper resistor and 2M2 pot.
The chip is triggered by a pulse from N4 and N3 and N4 create a short pulse while the 47u charges via the 10k resistor.
This has been done so the light falling on the photo transistor can be any length of time but the circuit creates a delay determined by the 4538chip.

All circuitry above can be done with a few gates of a Hex Schmitt Trigger chip (74c14 - CD 40014 - CD 40106):



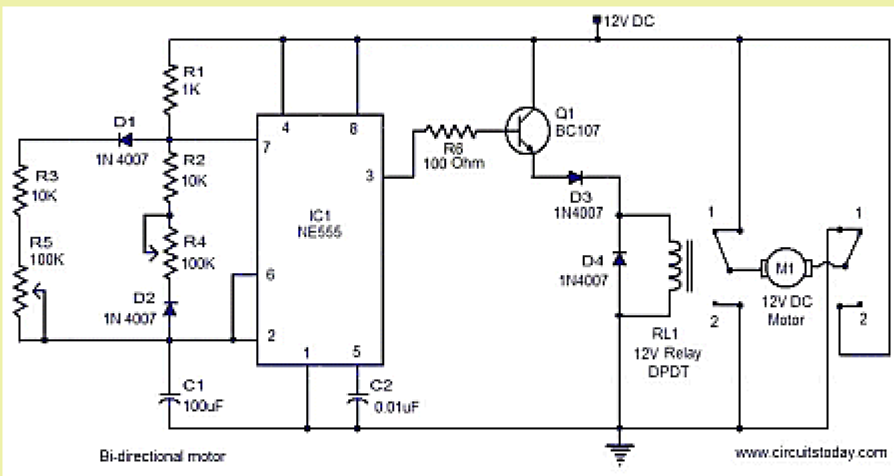
TP-107 Series Surface Mount Tape/Reel Test Points

The profile of the TP-107 readily accepts most commercially available spring clips and probes while providing a positive and secure anchor to the SMT board. Since a test point is subject to mechanical stress, the strength of its bonding, particularly on a surface mount design, is crucial. The TP-107 achieves this through a unique forming process which doubles the surface area of the test points mounting. This is accomplished by forming the flat wire design in a spiral wrap on the mounting base resulting in an adhesion to the solder pad which requires in excess of 18 pounds of force to dislodge the test point from its solder pad.

The photo does not really make it clear how the test points are added to a PC board. The photo should show a PC board containing surface mount components and include two or more test points.

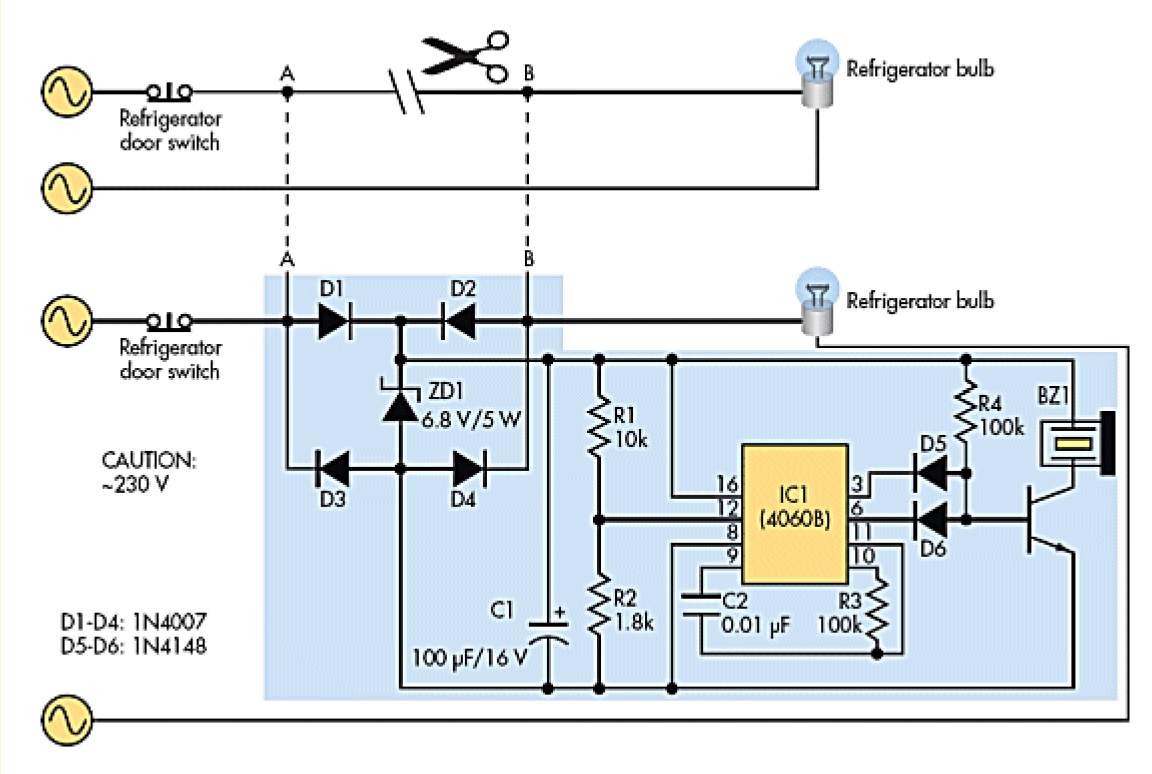
This request has bee sent to the manufacturer: Components Corporation We will let you know if we get a reply.

You always learn from some-one else's mistakes and here's another from **Circuits Today:**

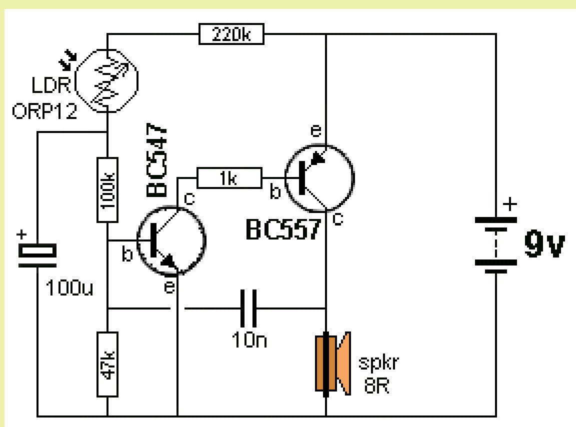


The main problem is the emitter-follower on the output of the 555. The 555 will only rise to about 10v for a 12v supply and the transistor will drop 0.7v plus the diode will drop a further 0.7v. This means the 12v relay will only get 8.6v The output transistor should be a common-emitter stage with 2k2 on the base. Diode D3 is not needed AT ALL. The diodes need only be 1N4001 1N4002 or 1N4004.
I have tried contacting **Circuits Today** on 12 occasions and not had a reply. This is the wonderful part of the web. You can release information without any experience and without any accountability. That's why you need to confirm everything you read with a second and third source.

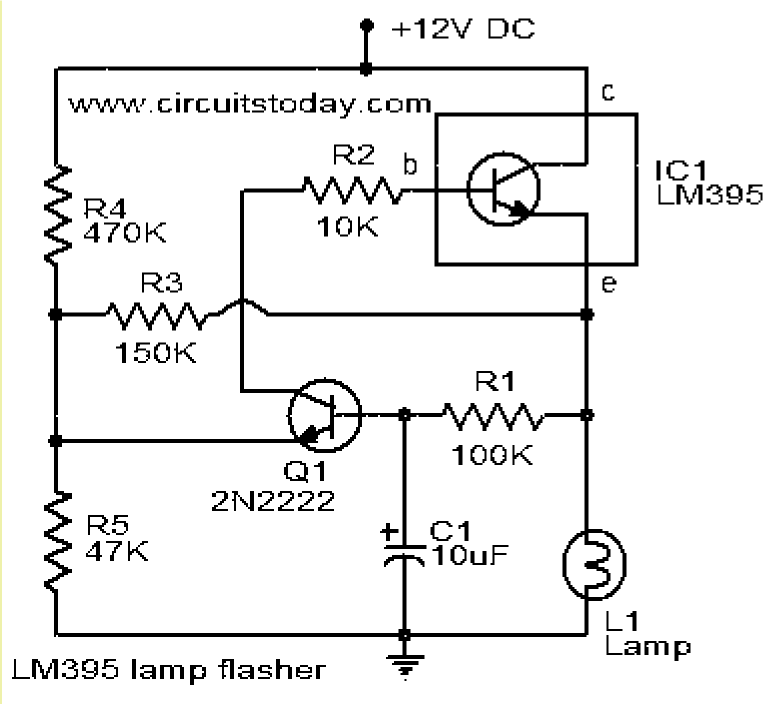
Here's a highly impractical circuit. How are you going to get at the wiring in a fridge?



Here is a simple circuit that starts to produce a sound about 15 seconds after the Light Dependent Resistor detects light:

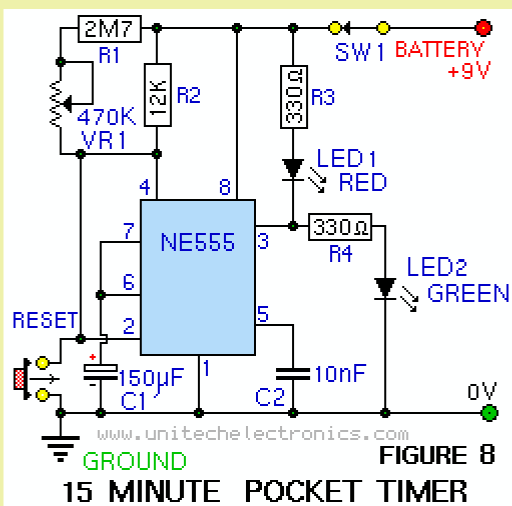


Here's another from **Circuits Today:**



The only problem with the circuit is the fact that it will not work. It will not start to oscillate. This is easy to see. How does the base of the 2N2222 get 0.6v to start to turn it on?
The only voltage divider on the base is the 150k and Lamp. The lamp will be about 20 to 50 ohms. The voltage it will provide is: 50/150,000 x 12 = 0.004V = 4mV!!!!
Thus is yet another circuit provided by the Indian website: **Circuits Today.**

Here's a circuit for you to find the mistakes:



Look at the 150u. What is charging this electrolytic? It cannot charge via pin 7 as this pin only connects to 0v when "active." It cannot charge via pin 6 as this pin is an input to a comparator.
And why connect approx 3Meg across a 12k resistor? And why connect pin 4 to the positive rail via a 12k resistor?

The circuit has now been changed on the website. The 150u has been changed to 220u (a value that is available - as 150u is not available). But it still contains a mistake. It's a very technical mistake.

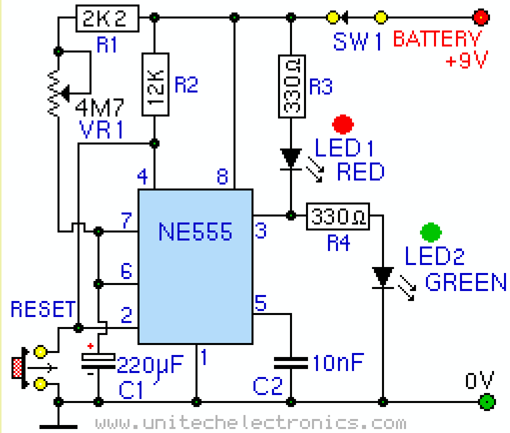
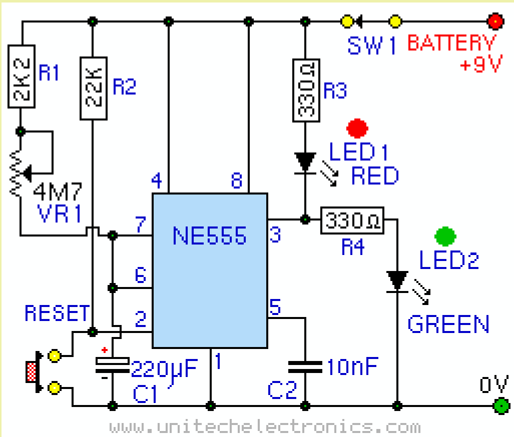


FIGURE 8
15 MINUTE POCKET TIMER

Pin 2 detects 1/3 of rail voltage on the capacitor and this pin is being taken LOW then HIGH via the reset button while resetting the chip via pin 4. But you cannot control both of these pins AT THE SAME TIME.
You must turn the chip ON by taking pin 4 HIGH, then a few microseconds later, take pin 2 HIGH. If not, pin 2 will not be recognised. The easiest solution is to keep pin 4 connected to positive and take pin 2 low via a 22k to start the timing as shown in the following corrected circuit:



15 MINUTE TIMER

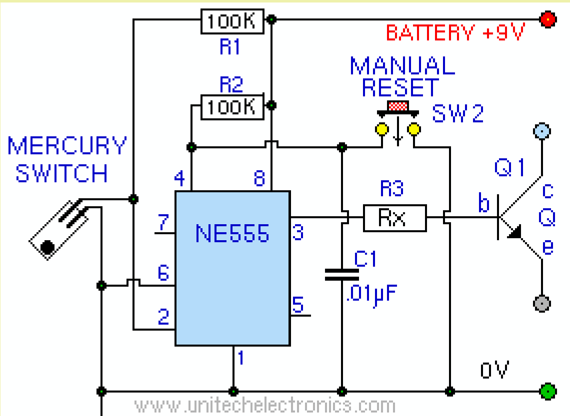
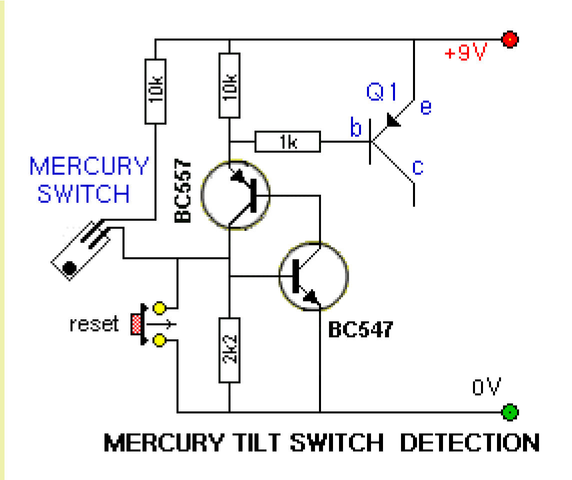
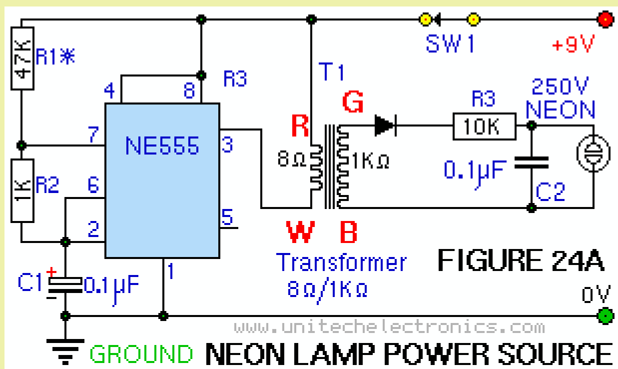


FIGURE 3
MERCURY TILT SWITCH DETECTION

The circuit above is a LATCH CIRCUIT. But it is consuming 10mA while it is sitting around waiting for the mercury switch to make contact.
By replacing the 555 with two transistors, the circuit will consume zero current when waiting for the switch to close.

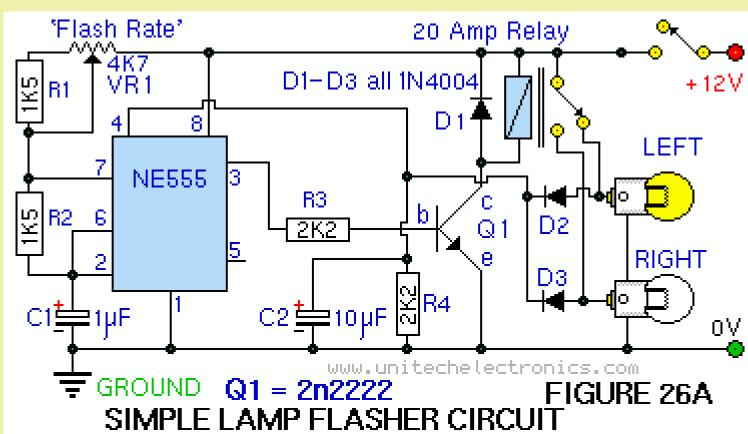


More faults:



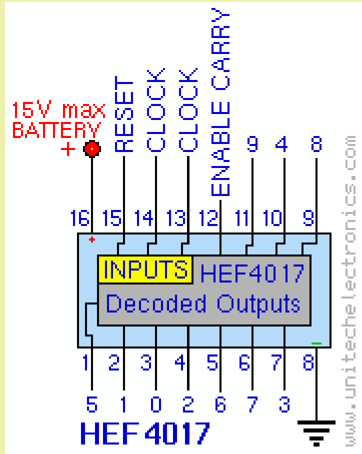
The 555 can only source 200mA and sink 50-100mA at 9v.
The circuit is trying to sink more than 200mA as the 8 ohm primary is an impedance value at 1kHz and the actual DC resistance will be less than 8 ohms.
The 555 will be overloaded by the output current requirement of the transformer. But the neon only needs a fraction of a milliamp so the circuit may work.

More faults:

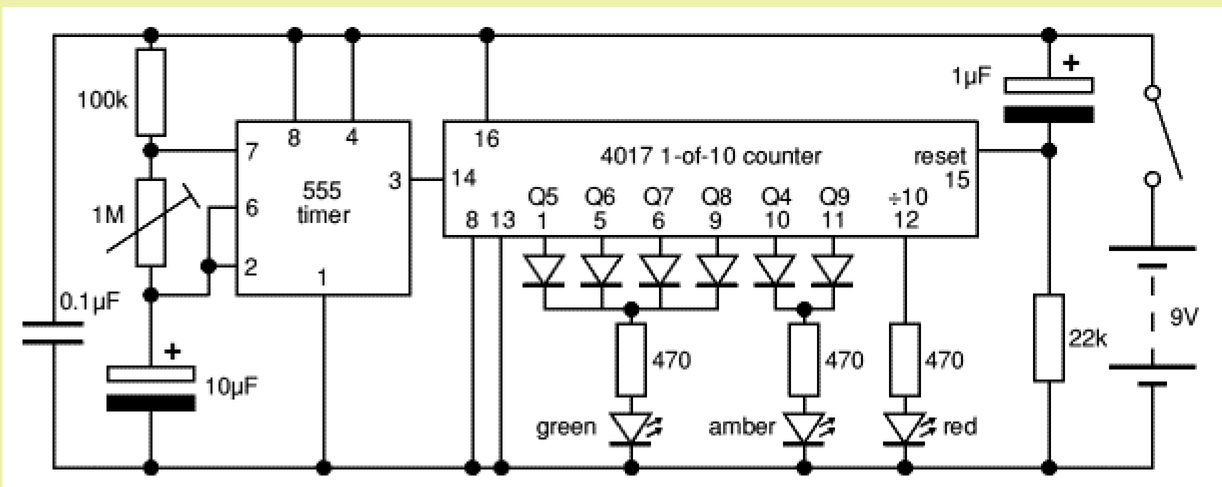


What is the purpose of the two diodes, 10u, and 2k2 resistor? The circuit keeps a "HIGH" on pin 4 all the time and these components are not necessary.
In addition, the 2N2222 can only handle 200mA and the 555 can source 200mA, so the relay can be connected directly between the output of the chip and 0v rail. The only problem might be the 555 only supplies 10v when on a 12v rail. It will have to be tested to see if the relay pulls in.

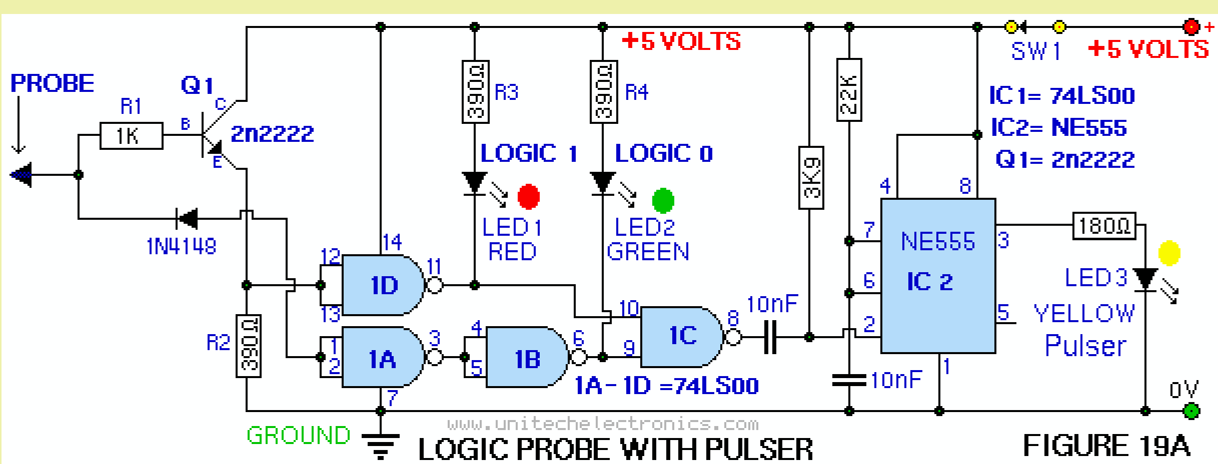
Here is a misleading pin-out:



Pin 13 is not a clock line, but CLOCK INHIBIT. When it is HIGH, the chip does not respond to the clock pulses on pin 14.
Pin 12 is not ENABLE CARRY but simply a "carry out" pin. It goes LOW at "5" and HIGH at "9." - remembering the first output is "0."
Here is a circuit that uses pin 12 to produce a TRAFFIC LIGHTS project:



Here's another:



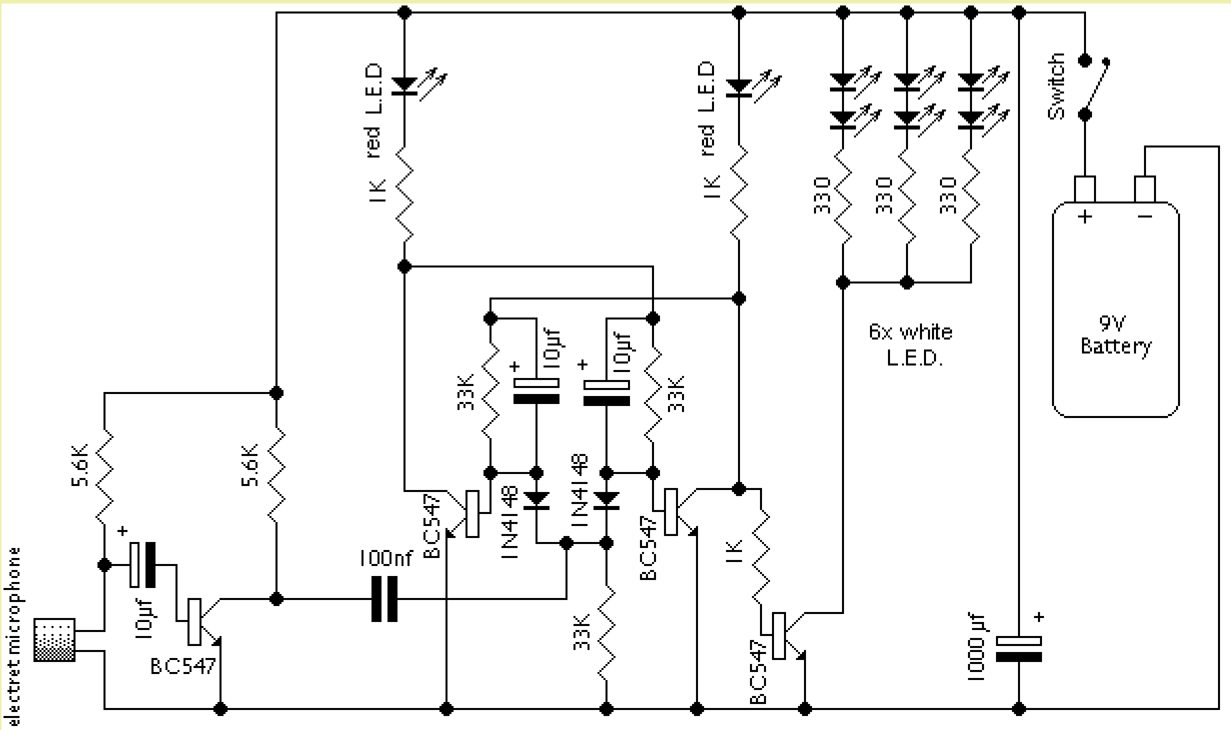
By connecting the LOGIC 0 LED between pin 3 and 0v, you free up one gate and this will give 2 gates to produce a pulse-circuit and thus you do not need the 555.

In addition, the circuit is described incorrectly. It should be HIGH, LOW, PULSE - a Pulser is a circuit that

injects waveforms into a project you are testing.
I should also point out that the **Logic Probe** is **not suitable** for CMOS (high impedance) circuits.

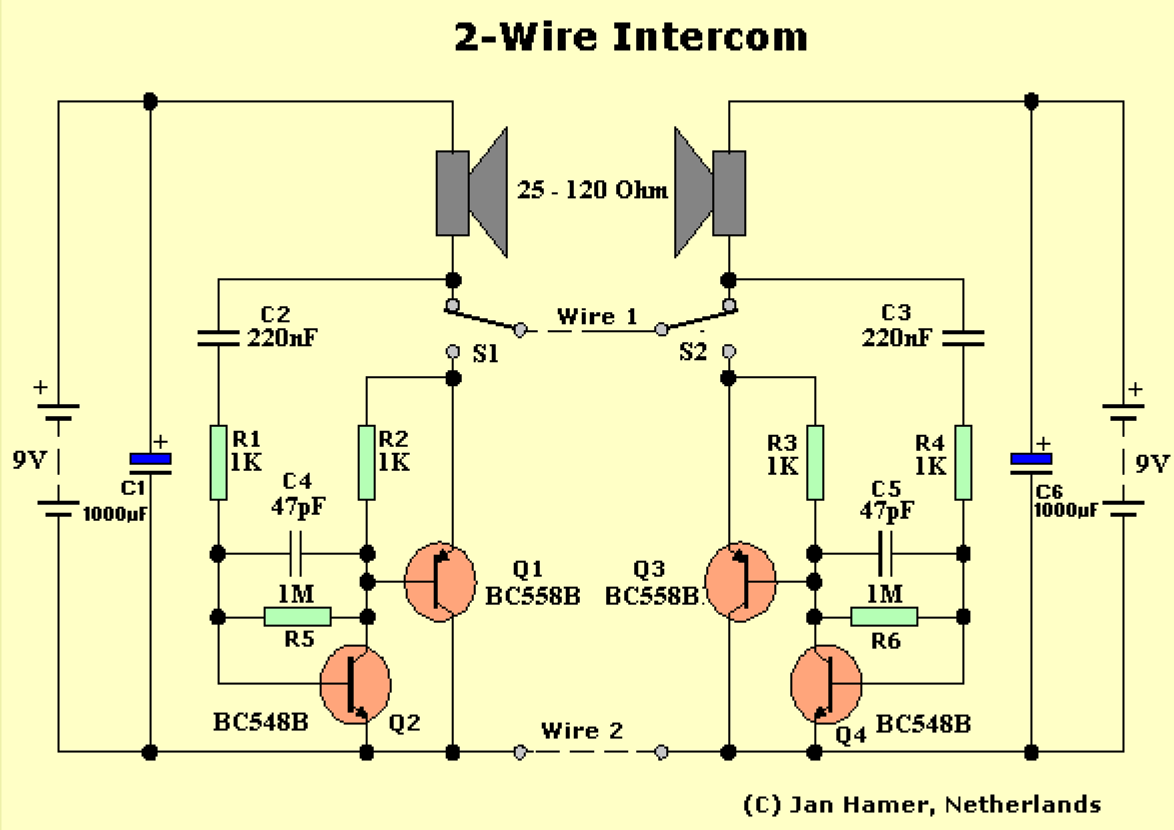
In all the circuits above, one of the things you must do is look at a circuit and see what is not needed and if it can be done in a simpler way.

Here's a circuit that doesn't work:



The electret mic does not produce enough voltage to turn on the first transistor.
See our improved circuit in "200 Transistor Circuits" eBook-2: **CLAP SWITCH**. Our circuit also responds to a whistle, tap and clap.

Here's a circuit that doesn't work:



The output from the speaker, when used as a microphone, is only about 20 - 50mV and the pre-amplifier does not provide enough amplitude to drive the output stage (buffer stage) to produce sufficient volume from the speaker. The output stage merely takes the amplitude from the pre-amplifier and increases the current-capability of the waveform about 100 times. In addition, our circuit works with common 8 ohm mini speakers.
It's a great improvement.   All it took was one extra stage of signal amplification (voltage amplification).
The improved circuit can be found in "200 Transistor Circuits" eBook-2: **INTERCOM**

The fastest way to learn electronics is to discuss circuits that don't work.
You learn two things. What NOT to do and WHAT to do.
It is very difficult to find a fault yourself and very difficult to see a technical mistake. Mistakes come in many different forms and most electronics enthusiasts don't want to do a lot of reading.
That's why we have explained everything with a circuit diagram.
When designing a circuit, test it by changing some of the components and see if it is "tolerant" of variations and get someone else to put a prototype together.
This topic started with a Key-Hole light that took 14uA when sitting around, instead of less than 1uA. The batteries lasted only a few months instead of a year and the importer went out of business.
A quick look at the circuit diagram would have shown the fault in the design - rather than waiting 3 months to see a load of flat batteries.
Two more points you will learn from this topic are:
1. Don't expect a circuit to work perfectly the first time it is developed. It may need many modifications and improvements. Be ready for this.
2. Don't expect a circuit presented in a book or on the web to work perfectly. It may contain hidden faults - as we have shown.

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SPOT
THE MISTAKES!

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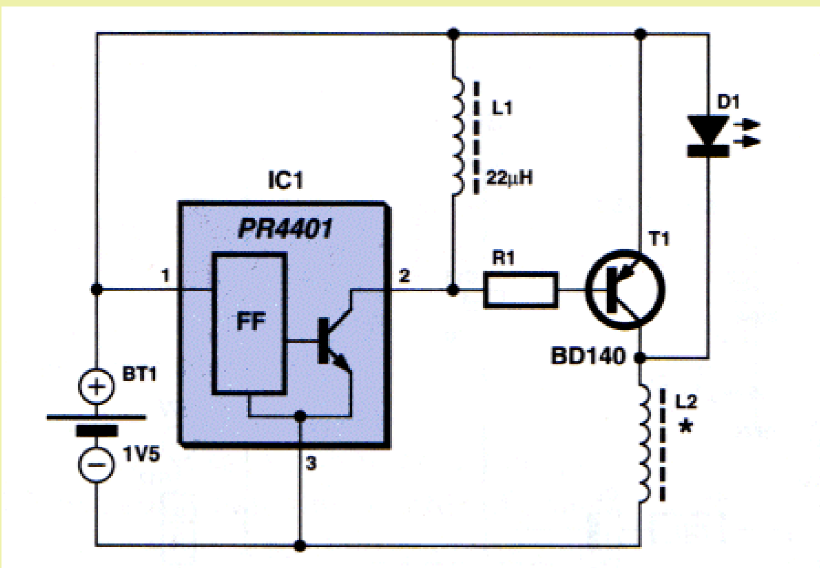
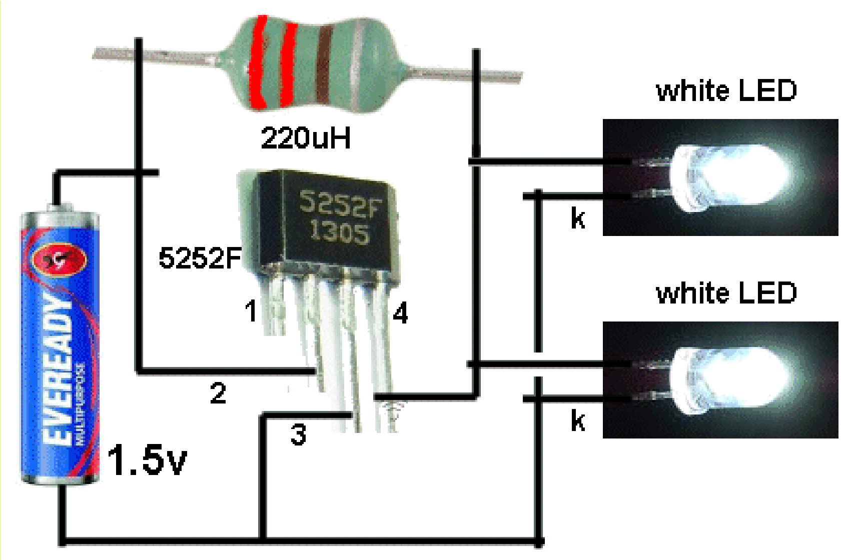
PR4401 1-watt LED Driver by TA Babu (India)

This is one of the worst circuits I have seen. It uses a PR4401 to drive a BD140 from a 1.5v battery.



The PR4401 normally drives a LED with 20 - 40mA from a 1.5v cell and will operate to 0.9v. The chip and circuitry is about 85% efficient but when an extra inductor is involved and BD140, the efficiency drops to about 70%.
On top of this, the energy from a cell when trying to deliver 1watt, is only about 60%. Putting this all together gives a very poor result. The current from the battery will be more than 1AMP! Show me a single cell that will deliver 1AMP. This is really an absurd way to go about things.
It would have been much better to use 4 cells and drive the 1-watt LED via a buck regulator (current-limiting arrangement).
The cost of the PR4401 is about 60¢ to 80¢ and I have yet to see it in a product - other than in a hobby circuit or an absurd design like this.

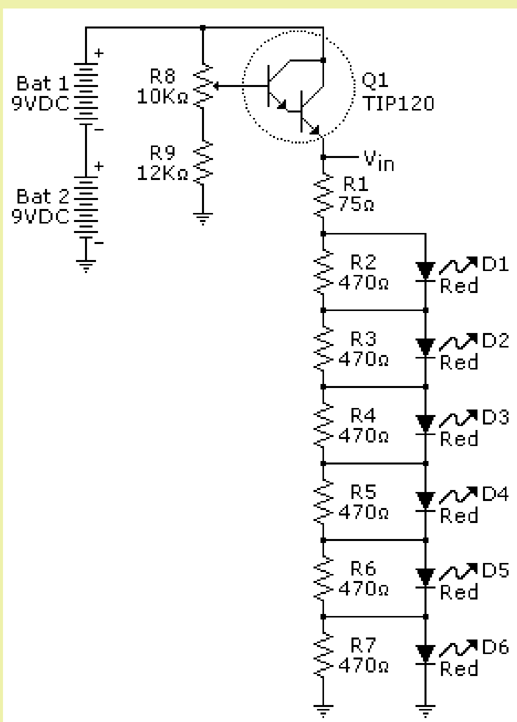
An equivalent IC (chip) has come on the market for 10 cents and it is a better chip.
Here is the circuit for QX5252F:



Using 220uH, the circuit takes 13mA an illuminates 2 white LEDs very brightly.
Using 100uH the circuit takes 30mA and the LEDs are really the same brightness.
Using 33uH the circuit takes 80mA and the LEDs are just about the same brightness.
Obviously the 220uH creates the most efficient circuit.

The PR4401 only delivers about 20mA. The QX5252F delivers more than 100mA.

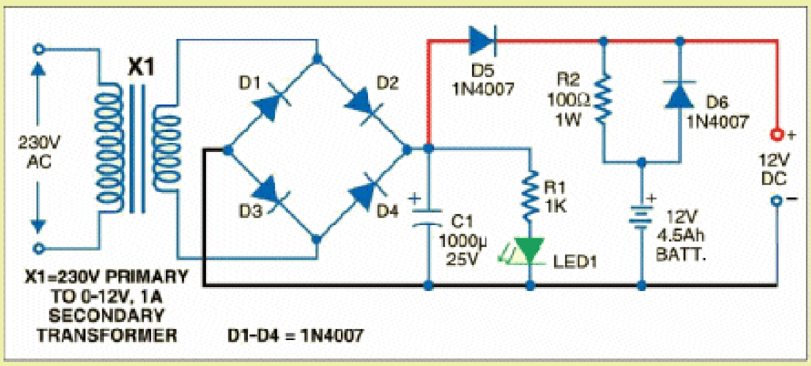
Here's a circuit from "**All About Circuits**:" It has four technical faults; Can you spot them?



Firstly the Darlington transistor is not needed. It can be an ordinary transistor. And it doesn't have to be a "power" transistor. The circuit is taking a maximum of 25mA
Secondly, the 75R current limit resistor does not give very much tolerance for changes in supply voltage. A change of 1v will alter the current through the LEDs by 13mA. Most LEDs run on 15-25mA MAX and if the voltage drops by 1v, they will dim considerably.
Tthirdly, the 470R resistors do NOTHING.
But the biggest mistake is the WHOLE CIRCUIT. As you adjust the pot, the voltage starts at 9.8v and the 6 LEDs require 10.2v. So none of the LEDs illuminate. When the pot is turned to 10.2 + 1.9v the LEDs are taking 25mA and this is the maximum allowable. This means the pot is turned 1.9/7.8 = 65 degrees before the LEDS "burn out." What a disastrous circuit!
I also have another point of disagreement. Why use 18v to drive 6 LEDs. Since only about 11v

is needed, you are wasting over 40% of the energy from the batteries.
You could drive 8 LEDs from a single battery as 4 LEDs in one string and 4 LEDs in a second string, and use less energy.
If you are going to design a circuit and add components such as the 470R resistors above, test the circuit to see if they have any effect.
This is one of the last things I do when designing a new circuit.
I gradually remove each component to see if it has any effect. Sometimes I have removed over 10 components that had little or no effect on the performance.
And sometimes a re-design results in 3 or 4 fewer components.
It's very embarrassing to find someone has omitted 10 components and the circuit works exactly the same.
Don't let this happen to you. Ask yourself, "What is each component doing?"
This circuit has obviously NEVER BEEN TESTED.

Here's another circuit from **Electronics For You**, an Indian publication. It appears to be correct, until you see the 100R resistor charging the battery.
The transformer is 0-12v AC and this will produce a DC voltage at least 18v-20v after rectification, on no load or when powering the alarm during normal conditions. (It could be as high as 22v).
This voltage is far too high for a 12v battery and it will cause gassing and the battery will dry out in a few months.
It is absolutely essential to charge the battery until its voltage reaches 14.1volts then turn-off the charging voltage so that the battery does not produce bubbles. This circuit does not do that.



Here's a simple circuit that was improved 50% by simply changing the position of one component. The original current was 30mA. After changing the position of the 470R resistor, the current dropped to 17mA with the same brightness from the white LED.
The reason is simple.
In the first circuit, the BC557 is acting as an emitter-follower to the signal (current) delivered by the 1n and it is taking much longer for the two transistors to turn on. In the second circuit, the two transistors turn on much faster and less wasted current passes though the inductor.
(Even the wording for Figure 1 in the fig below, is misleading. The LED is illuminated by the spike produced by the reverse-voltage from the collapsing magnetic flux of the inductor - the 2-transistor amplifier is merely the driving mechanism.)

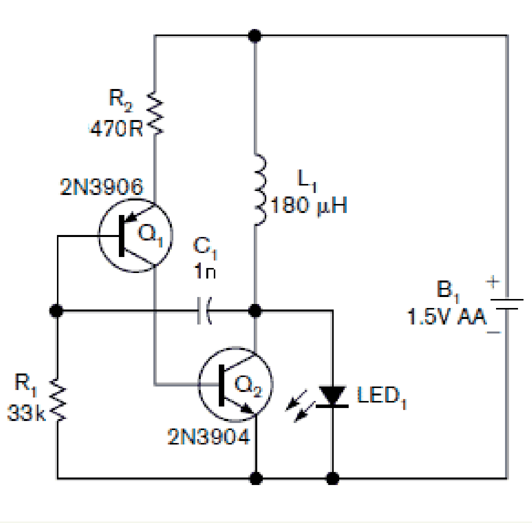
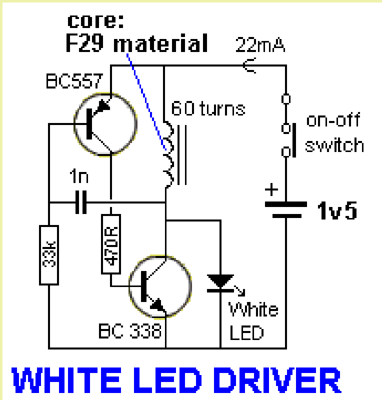
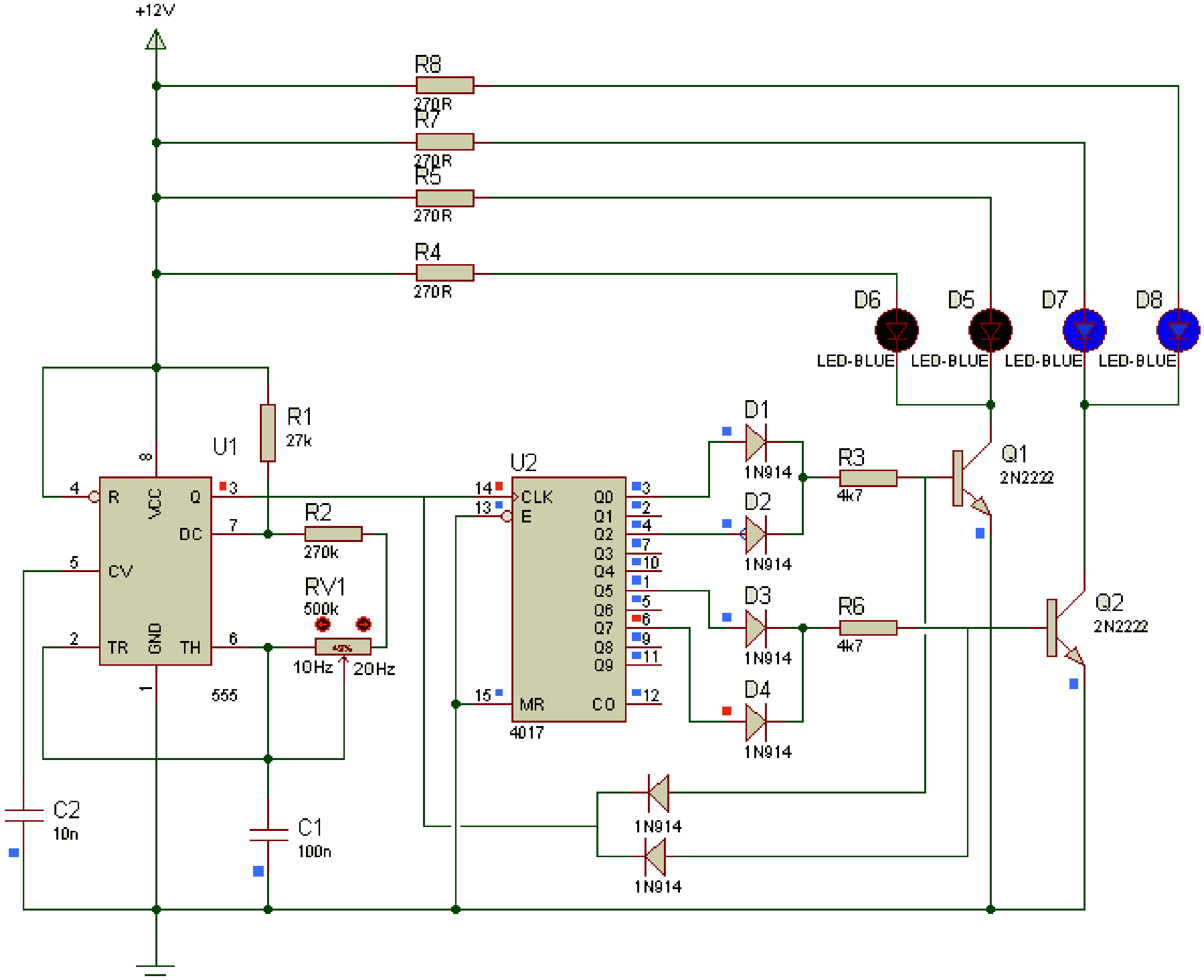


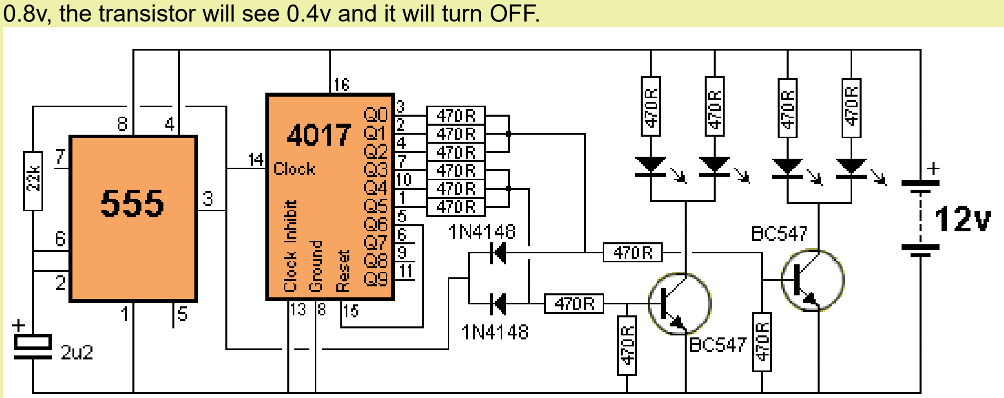
Figure 1 This two-transistor circuit operates as a high-gain amplifier to light LEDs.



Here's a circuit that was designed from a simulation software package. While these packages are fairly good, they do not contain all the data and mysteries that come with actually using a component.
I have found some BC547 transistors that do not work in 88MHz FM transmitters. And some 74c14 ICs that produce a different frequency in an oscillator. These irregularities are never covered any any simulation package.
You must build a circuit to prove its reliability and operation.

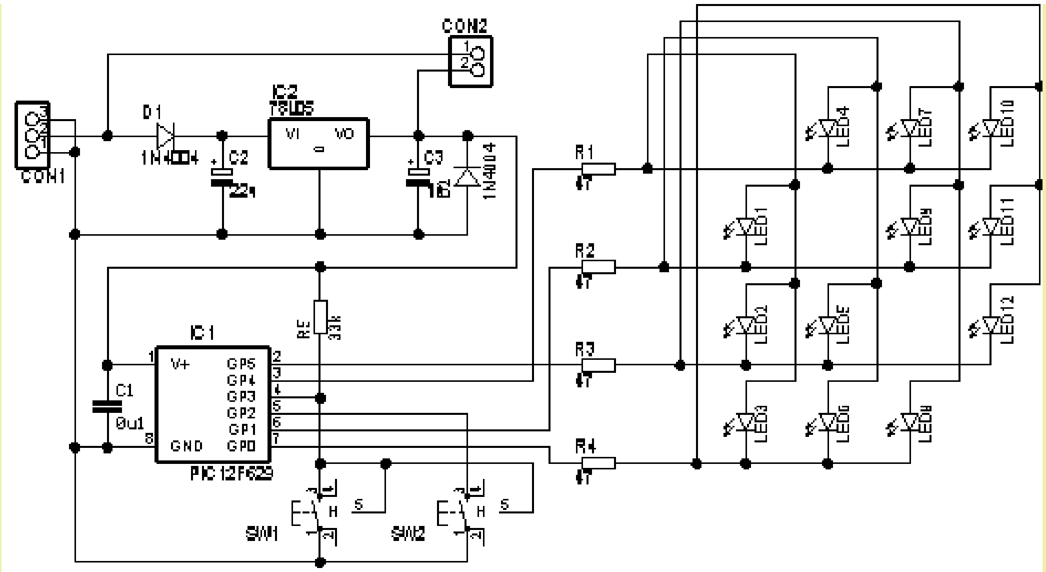


The fault with the above circuit lies in the fact that the output of a 555 is about 0.2v to 0.5v above the negative rail when outputting a LOW.
When this is combined with a gating diode, it produces a voltage of about 0.8v on the base of the driver transistor and this will NEVER turn the transistor OFF.
The remedy is to include a voltage-divider network made up of two resistors. In the following example, the 470R between base and 0v and 470R between base and gating diode, form a voltage divider. The best way to see their operation is to remove the buffer transistor.
To produce 0.6v on the join of these two resistors we need to supply 1.2v at the top.
This is what is now needed to turn ON the transistor and if the gating diode produces a voltage of 0.8v, the transistor will see 0.4v and it will turn OFF.

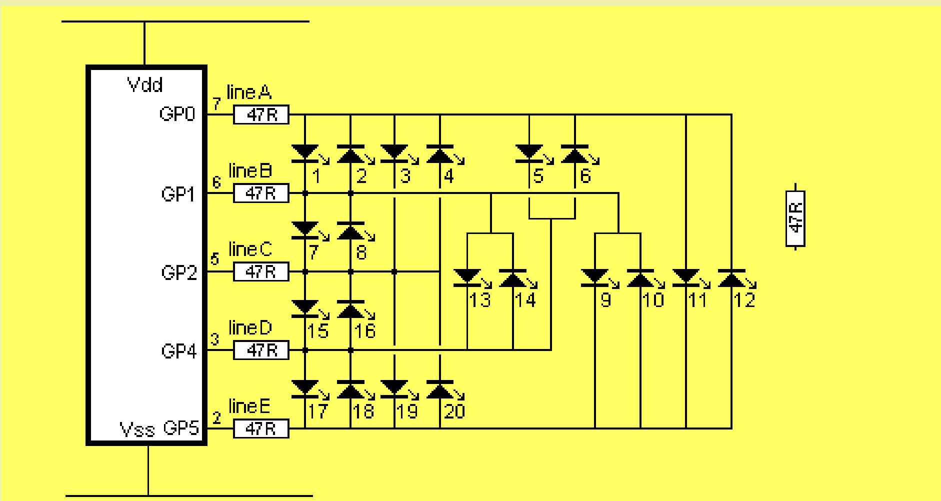


POLICE LIGHTS - 2

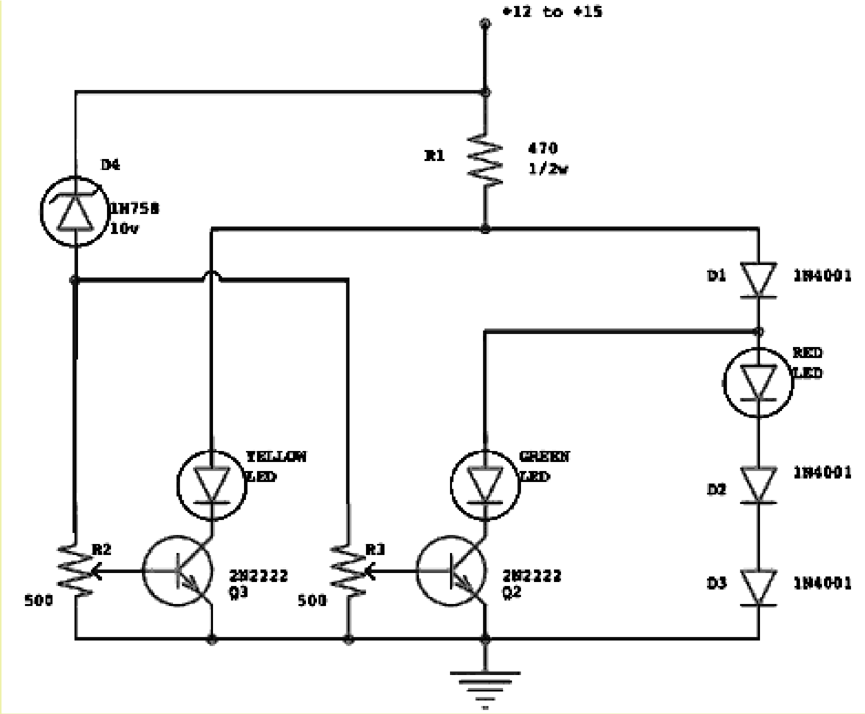
This next mistake highlights the need to draw a circuit so that it is immediately obvious how the circuit works.
At first impression, the first circuit appears to be scanning the LEDs in a 3x4 matrix, as the LEDs are all drawn in the same direction:



However when the LEDs are re-drawn as shown in the following circuit, we can see the arrangement is known as Charlie-Plexing.

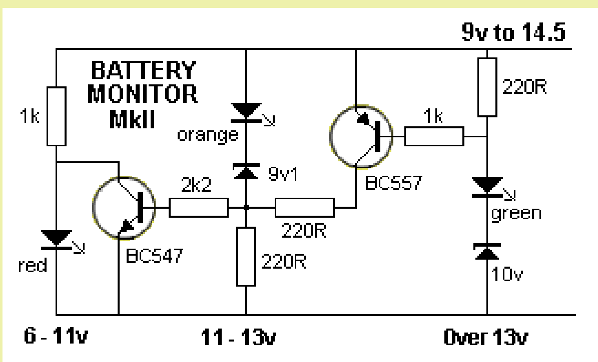


Here's a circuit with a couple of mistakes:
It operates as follows:
The Red LED illuminates if the voltage is below about 12.5 volts.
The Green LED begins to light at about 12.5v and the Red LED fades, at about 14.25v the Yellow LED begins to come on and by 14.75v the Green LED has faded out.



If the pots are turned to one end; the zener, pot and transistor will be damaged. A 1k resistor needs to be placed between the base and wiper of the each pot.

Here is a circuit designed by Talking Electronics to monitor a battery:



The red LED turns on from 6v to below 11v.
It turns off above 11v and the orange LED illuminates between 11v and 13v.
It turns off above 13v and the green LED illuminates above 13v

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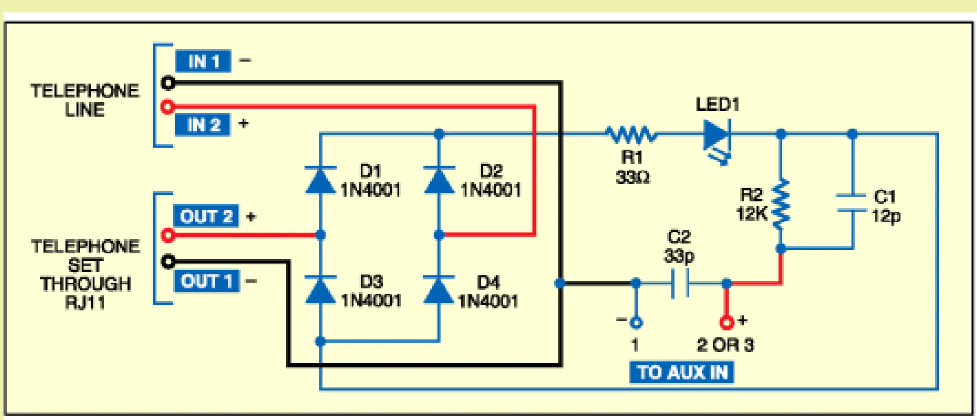
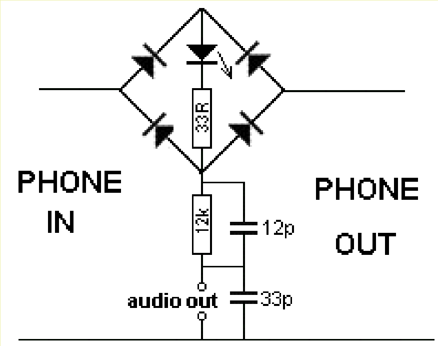
Here's another circuit from **Electronics For You**, and Indian publication:



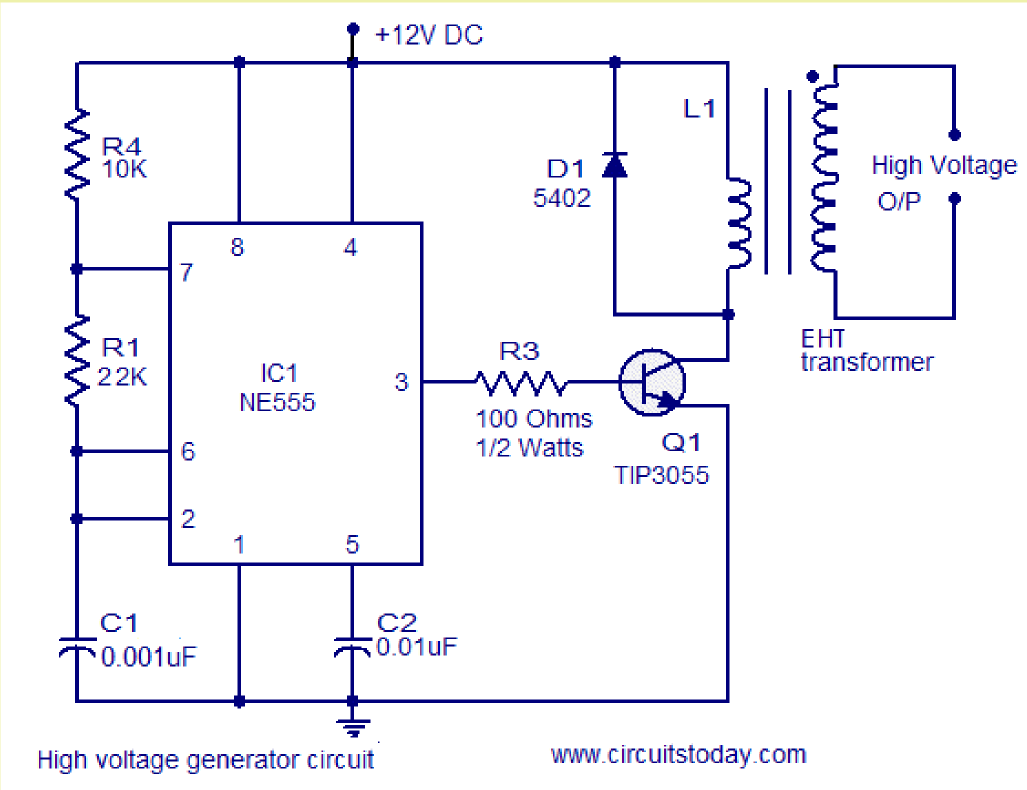
The first thing I have always said is this: Always draw a circuit so that it is easy to understand. I have absolutely no idea what the 4 diodes are doing and how the circuit is actually connected to

the two phones.
By re-drawing the circuit, this is much easier to see:



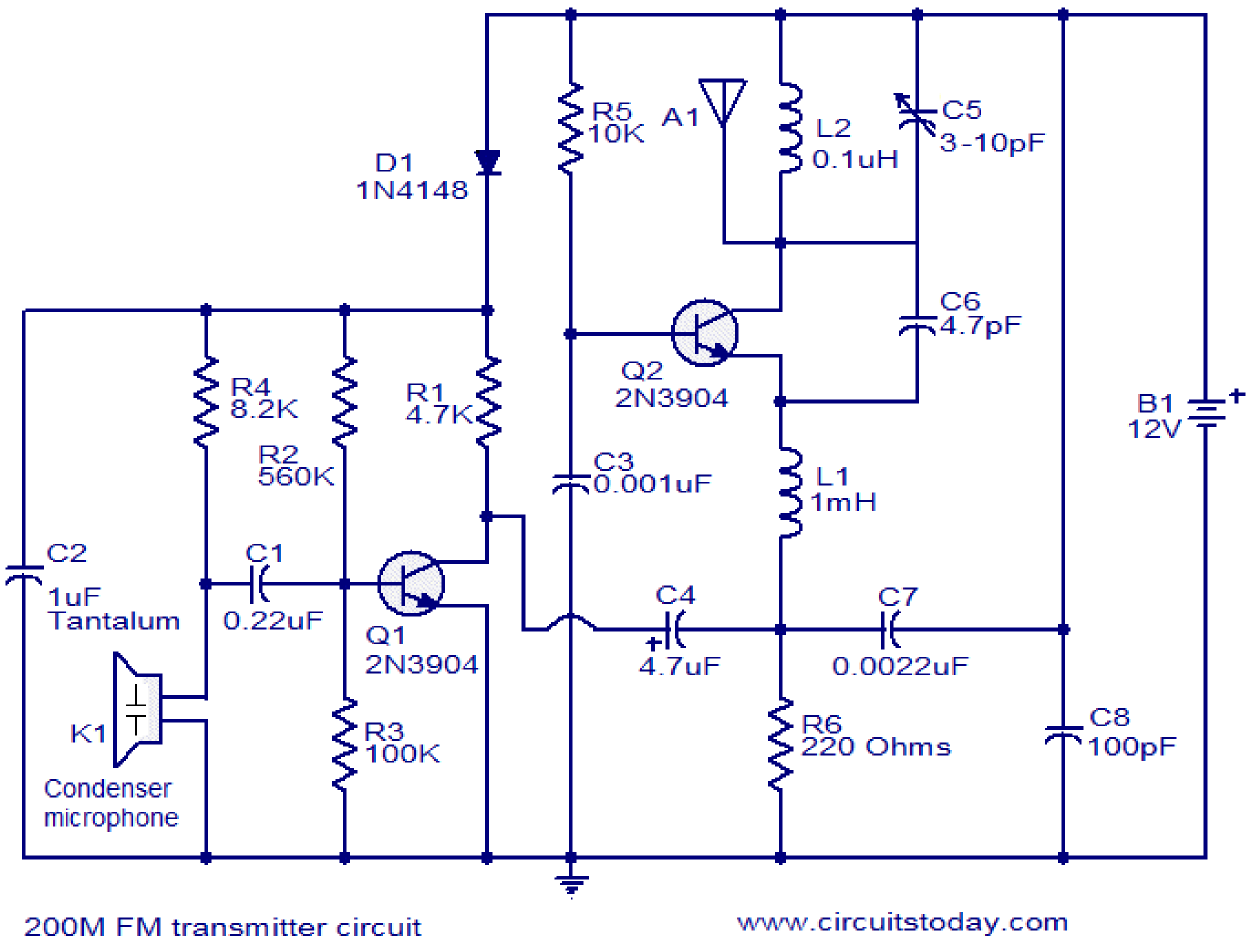
The 4 diodes are a bridge and the LED is turned on when the phone is picked up. The circuit can be connected to the phone line either way as the diodes are wired so that the LED always illuminates. But the 33R has no effect at all and can be removed.
Secondly, the 12p and 33p have no effect on the audio. They should be in the range 10n to 100n to have any effect at audio frequencies.

And yet another circuit from an Indian website:



The EHT transformer will only produce 8kv-10kv when used in flyback mode. This requires the transistor to turn off very quickly at the time when the transformer is reaching saturation. It is very important that the timing for the transistor is accurately controlled and this requires a feedback signal from the transformer. This circuit does not provide that feature.
Secondly, NO TRANSFORMER is going to produce an extra high voltage when a diode is connected across the primary. This diode will completely absorb the energy from the collapsing magnetic flux and prevent a high voltage being produced.
Nearly every circuit from CircuitsToday has a fault as nothing is tested before being written up on the web.

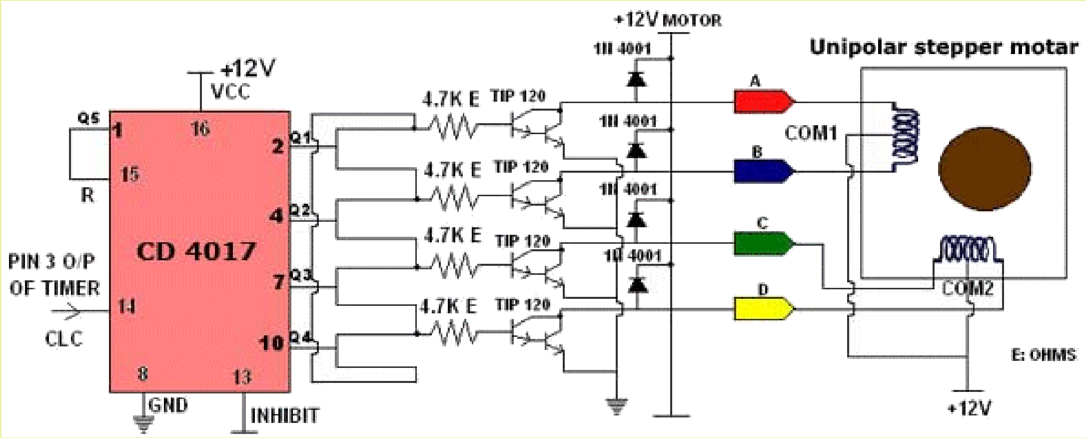
More from **CircuitsToday.com**:



There are many faults with this circuit.
1. The 1u tantalum can be an ordinary electrolytic.
2. The 8k2 resistor should be about 47k
3. The 220n should be about 22n
4. The diode does not serve any purpose.
5. The 10k resistor should be at least 47k
6. The 0.1uH should be about 0.06uH
7. The 3-10p should be at least 22p
8. The 100p across the battery should be at least 22n.
9. The 220R resistor should be at least 470R
See our series on designing FM transmitters and you will learn how to design circuits like this and not make the mistakes contained in this circuit.

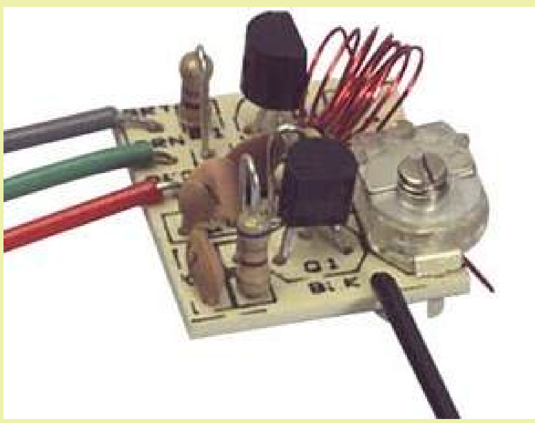
Here we have a 4017 driving 4 buffer transistors.
If you look carefully, you will see the 4 outputs of the 4017 are connected together.
Each output of a 4017 is bi-polar. In other words it drives HIGH or LOW. At 12v, each output will deliver about 100mA when driving a short-circuit. When one output is HIGH, it is driving three LOW outputs and this will put considerable strain on the chip. In the following circuit, each output will rise to about 3v and that is why the designer thought the circuit would work. But this voltage is produced under enormous strain inside the chip. The outputs should have either gating diodes or resistors to prevent overload.
The designer of the circuit considered the chip and stepper motor would take zero current when the chip is reset, (the 6th output - pin 1 - goes to reset) but he did not provide any feedback from the 4017 to tell the oscillator when to stop providing clock pulses. If the 4017 sits with any output HIGH, the current consumption would be considerable.
Secondly, the circuit would NEVER work as ALL THE OUTPUTS are connected together and all the Darlington transistors are turned on AT THE SAME TIME!
I have also asked him how the circuit guarantees to remain in reset mode when not required. In other words, what happens if the 4017 receives 3 pulses (or any of 3+5+5+5 etc). There needs to be feedback from the 4017 to tell the "clock" when to stop sending pulses. In other words, the clock needs to know where the 4017 is.
I have contacted the author of the circuit: shoumik banerjee schawn143@yahoo.com and he now claims the circuit has never been tested. Only a fool puts a project on the web without building and testing it. Not only that, but it is totally unfair to other readers, who may build the circuit and find it has no chance of working. That's why you have to be careful with everything you find on the web.

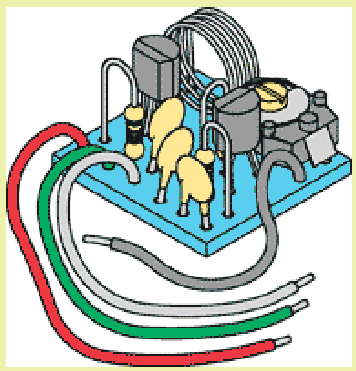
I have seen some "impossible" circuits that work and some that should work, but don't.

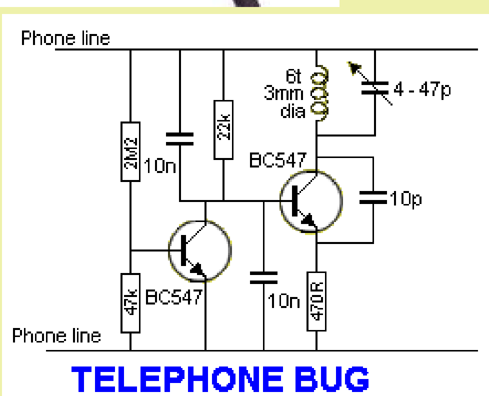


TELEPHONE BUG

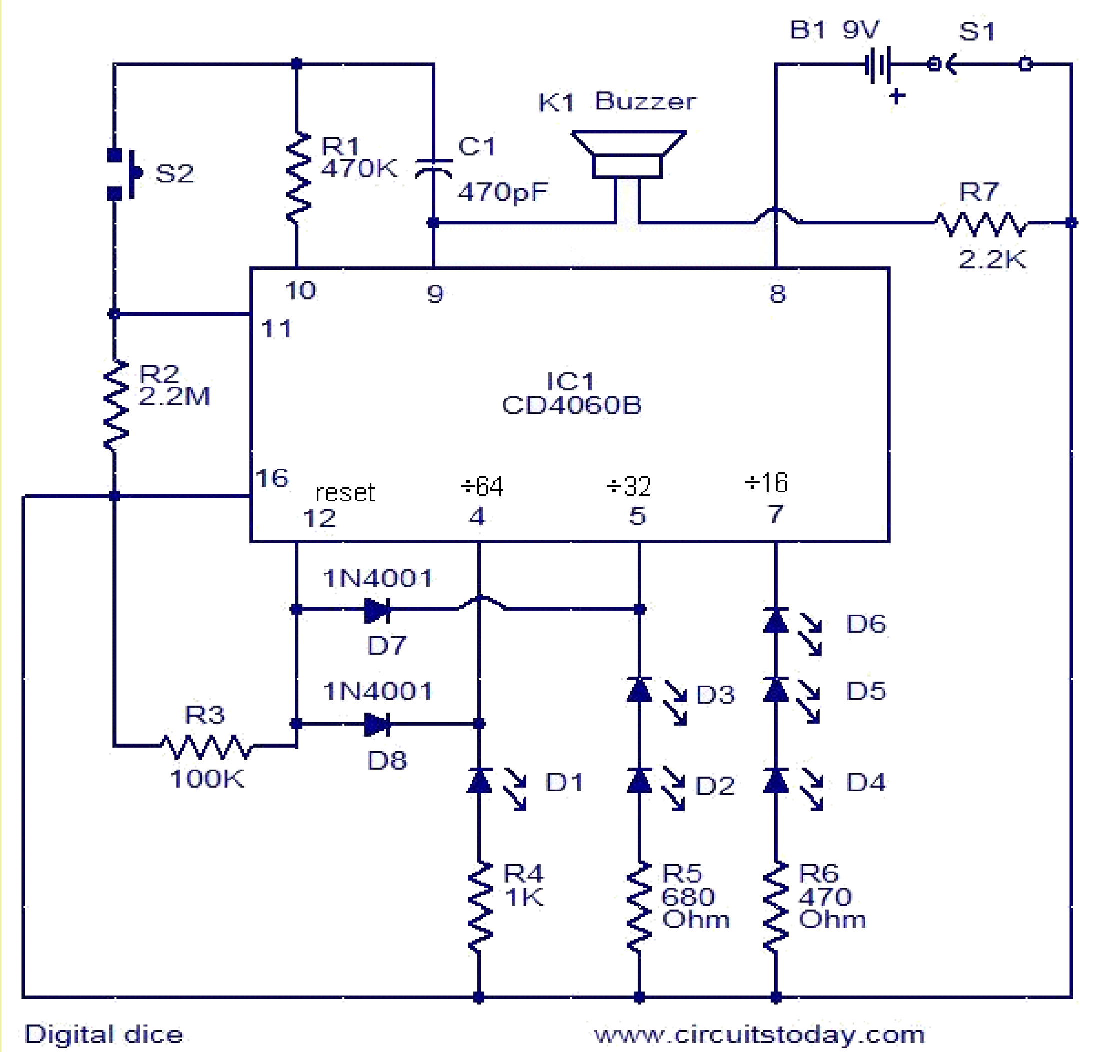
Look at the coil. A floppy coil like this is totally unsuitable as it will be "telephonic." This means it will vibrate when bumped and will even pick up sounds such as talking, music and footsteps, and transmit them, just like a microphone. I suggest you build this circuit and use 7 turns of thin wire on an 8-10mm pen and see how the coil picks up every sound in the room. Simply connect a 9v supply and the circuit will work. The coil should be 6t and 3mm diameter.





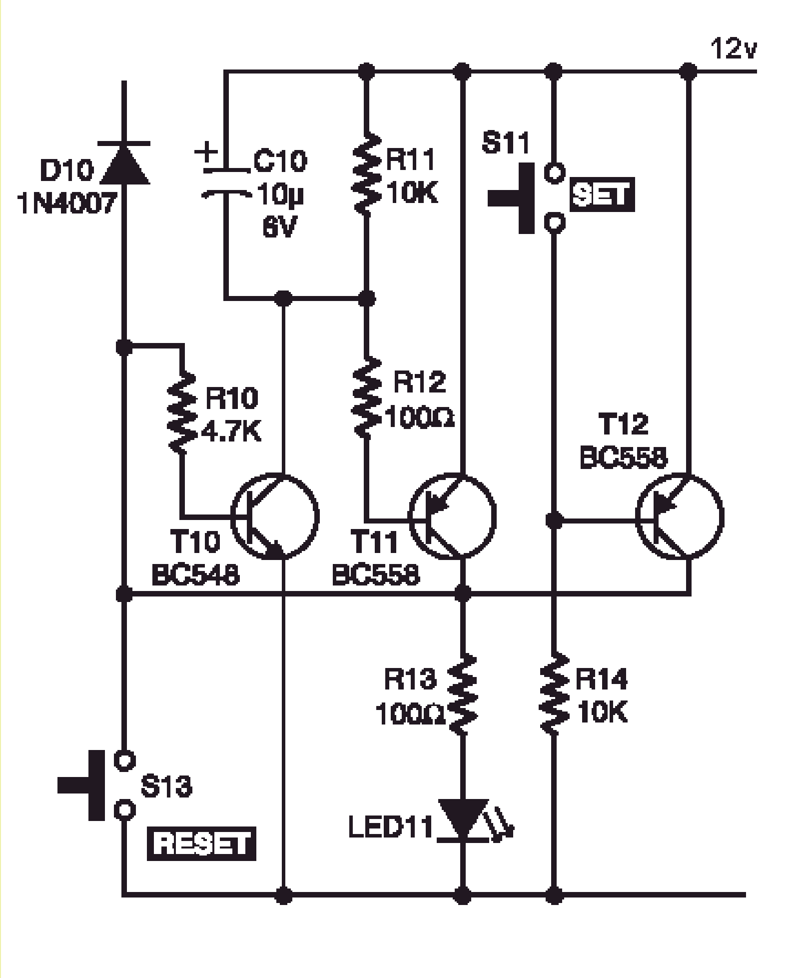


Here's another **CircuitsToday.com** disaster:



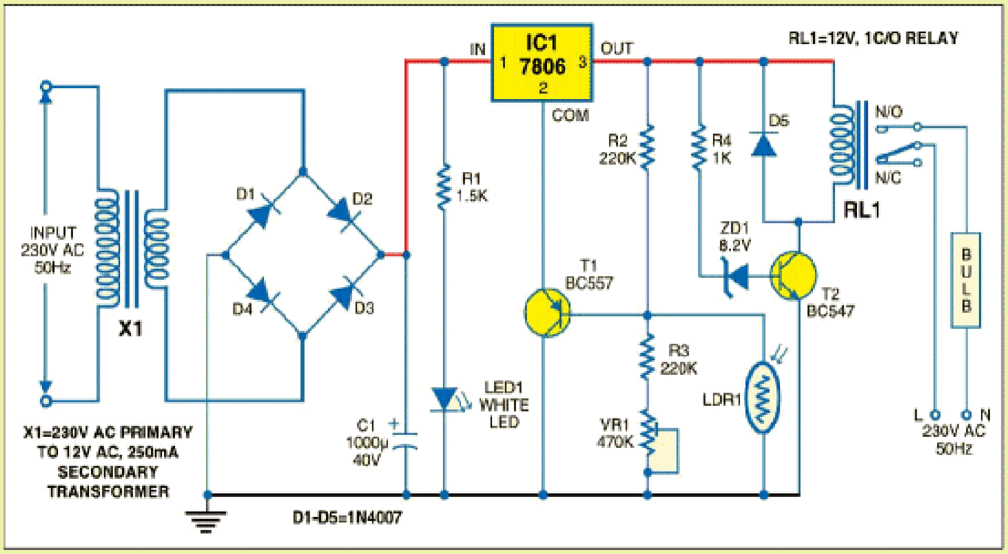
Apart from the circuit being up-side-down and difficult to work out how it operates, output pin 7 will illuminate 3 LEDs more often than pin 4 with the single LED. In fact the Digital Dice is biased by an amount of 4:1 and is totally unsuitable for any game that requires an unbiased dice.

Another **INDIAN** disaster:

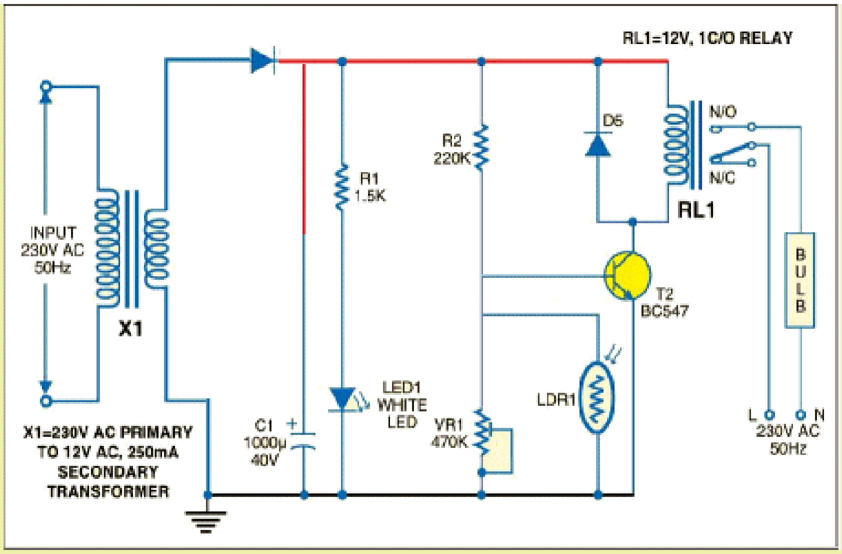


Note: the RESET switch shorts transistors T11 and T12 across the power rails. This is a very bad design fault and could be improved by placing the RESET switch between the base of T10 and 0v rail.

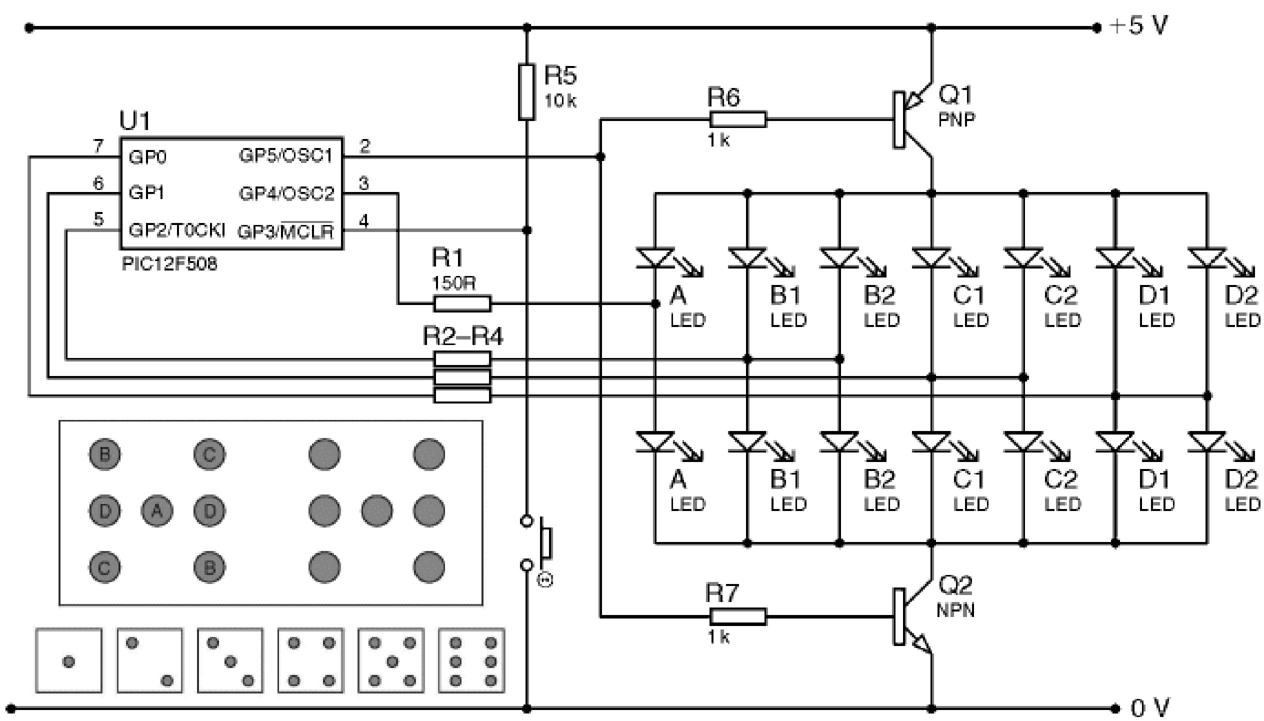
Here's another circuit from **Electronics For You**, the Indian publication:



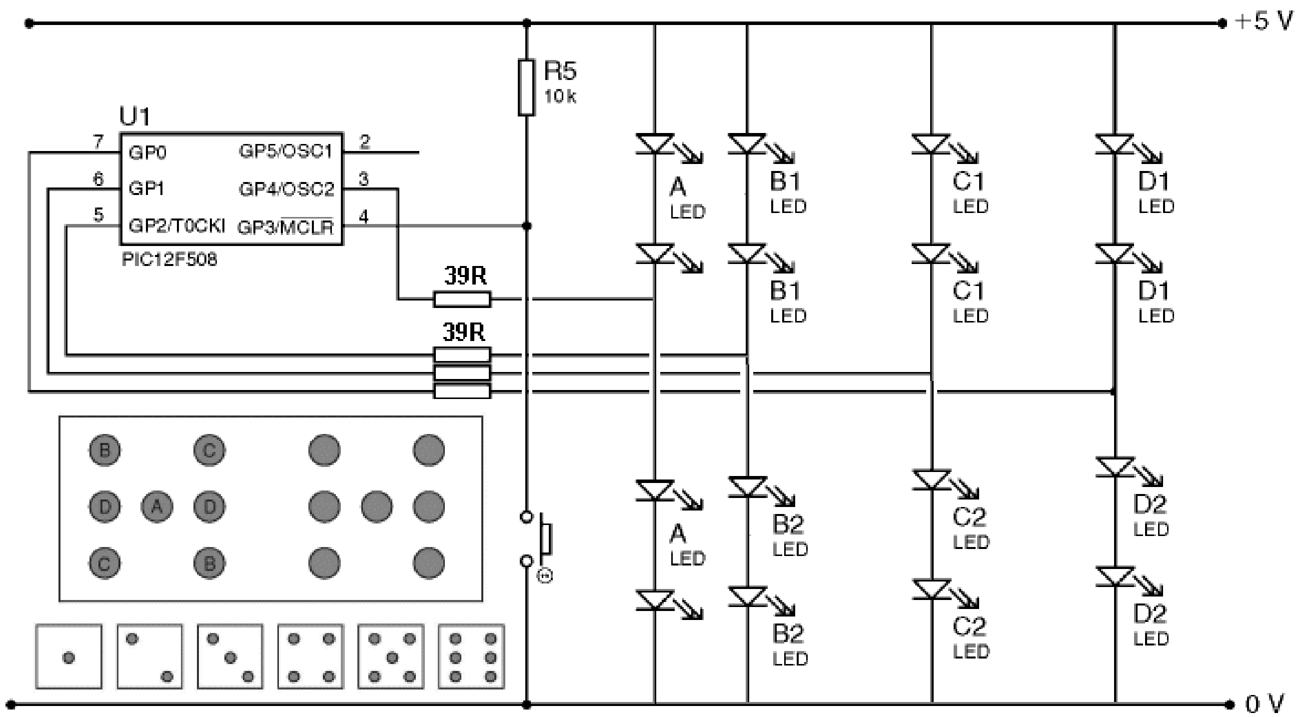
The relay is activated when light ceases to fall on the LDR. The resistance of the LDR increases and the BC557 transistor turns off. This allows the voltage on the common terminal of the 7806 to rise and the output voltage rises.
When the voltage rises above 9v, the base of the BC547 sees a turn-on voltage and the relay is energised.
This is a very complex circuit to perform such as simple task.
A much simpler circuit is shown below:



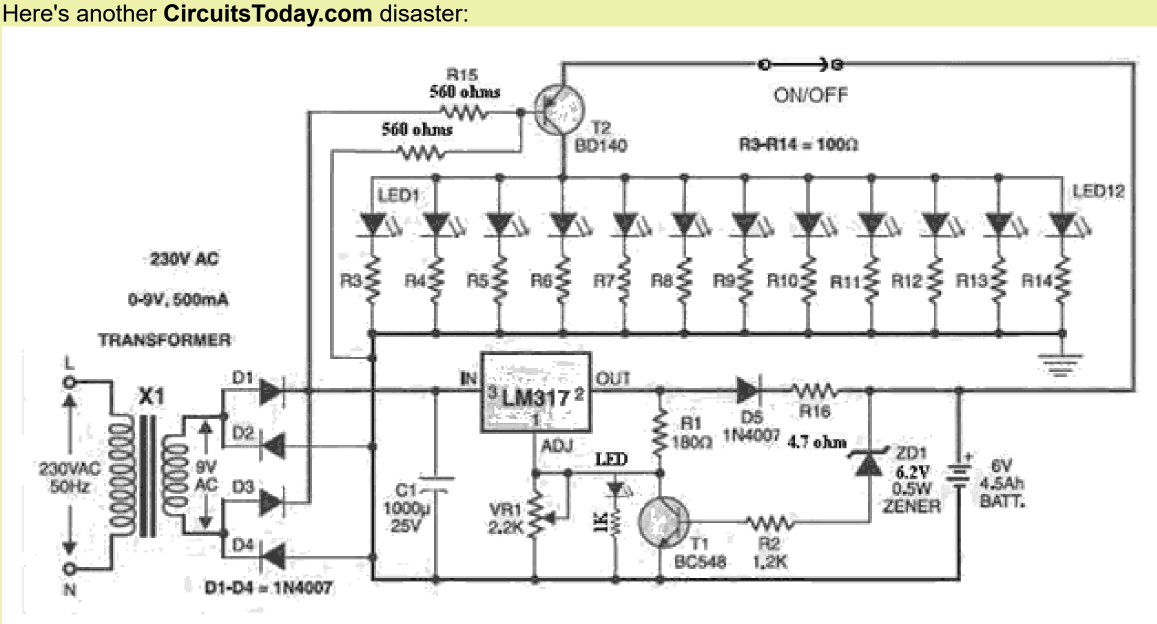
Here's a circuit from a renowned electronics writer.
It can be simplified considerably by realising the fact that the voltage drop across 4 LEDs is greater than 5v and they will not illuminate when not required.



Here is a simplified diagram: The extra LEDs in series with "A's" are to prevent the "A" LEDs illuminating when not required. They are not used on the display.



Here's another **CircuitsToday.com** disaster:



The circuit takes 300mA. By placing 3 LEDs in series, the current will be reduced to 100mA. This is a 300% improvement. On top of this, many of the parts can be removed and the circuit simplified considerably. You have to "think outside the box" after designing a circuit and ask yourself: Can the circuit be simplified?

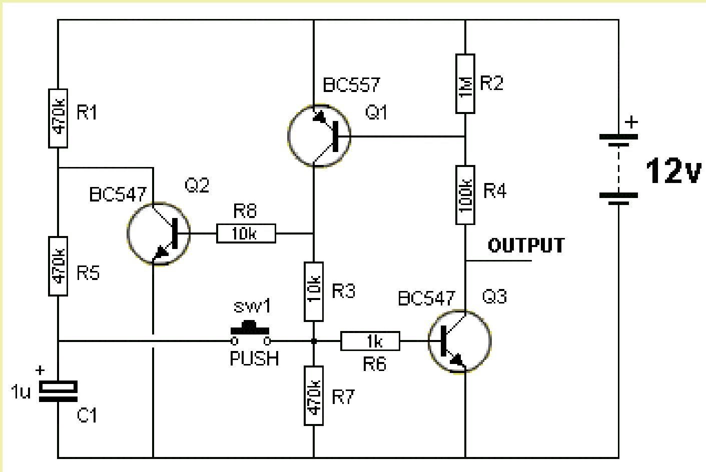
Here are two mistakes from DayCounter.com

http://www.daycounter.com/Circuits/Latching-Momentary-Switch/Latching-Momentary-Switch.phtml
http://www.daycounter.com/Circuits/Transformerless-Power-Supplies/Transformerless-Power-Supplies.phtml

I informed them of the mistakes and received NO REPLY.
The first circuit had no resistor on the base of Q2. When Q1 and Q2 are turned on, a very large current will flow through the emitter-collector junction of Q1 and base-emitter junction of Q2. Both transistors will be damaged. The 10k resistor limits this current.

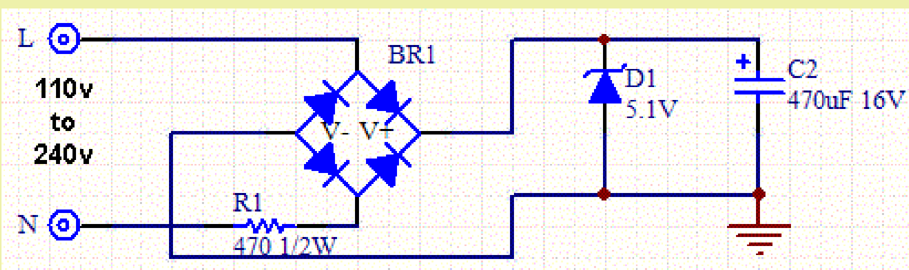
When the circuit is turned on, capacitor C1 charges via the two 470k resistors. When the switch is pressed, the voltage on C1 is passed to Q3 to turn it on. This turns on Q1 and the voltage developed across R7 will keep Q1 turned on when the button is released.
Q2 is also turned on during this time and it discharges the capacitor. When the switch is pressed again, the

capacitor is in a discharged state and this zero voltage will be passed to Q3 turn it off. This turns off Q1 and Q2 and the capacitor begins to charge again to repeat the cycle.



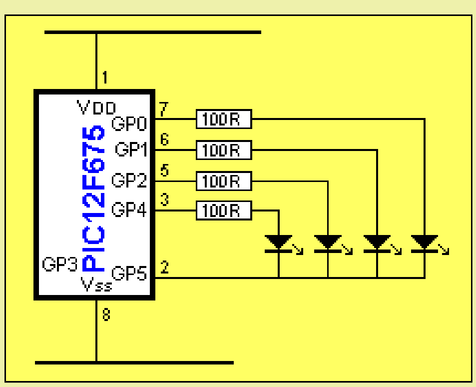
LATCHING A PUSH BUTTON

The second circuit shows a 470R 0.25watt resistor on the input. Even if the input voltage is 50v, the power dissipated by the resistor will be 5watt. Imagine the power-loss at 110v or 240v!!!!
We already know that a resistive power-supply is very inefficient and requires a very large resistor to drop the voltage, but obviously DayCounter.com has no idea.
See **The Power Supply** article on left Index for more details on capacitor-input and resistor-input power supplies.



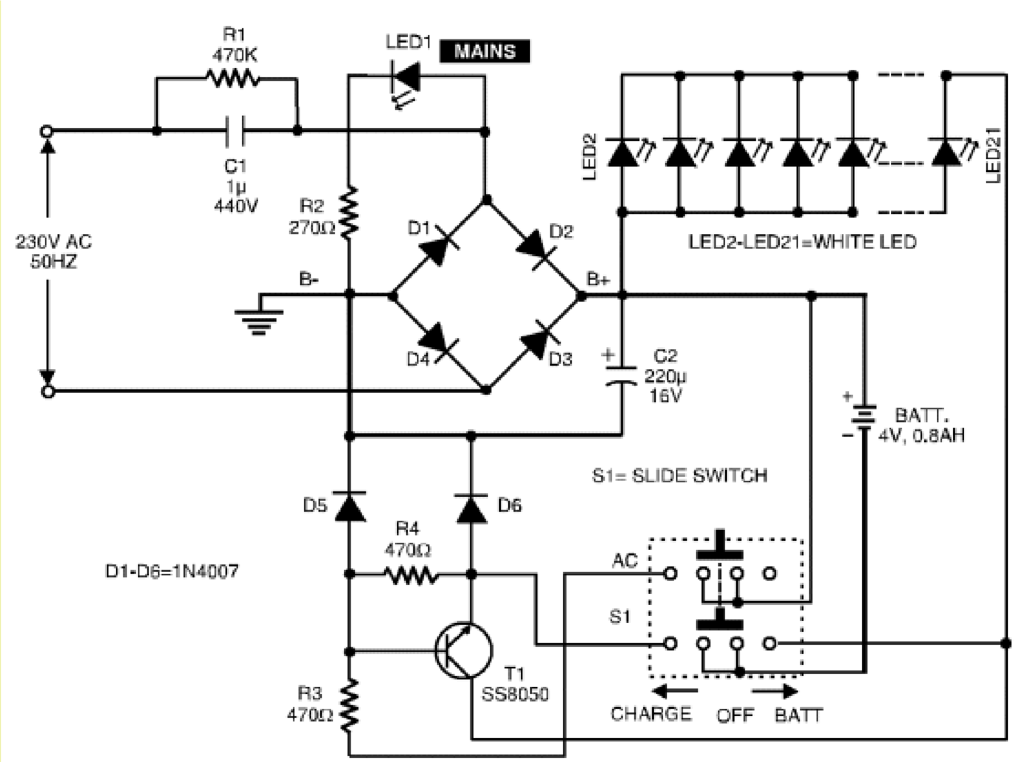
A MICROCONTROLLER CIRCUIT

This circuit drives 4 LEDs via 4 output lines with sinking via a single line on the microcontroller.
Each line can only sink or source 25mA. If GP0 is HIGH and GP5 LOW, the last LED will illuminate.
If GP1 is made HIGH, the two outputs will be able to deliver 25mA each to the LEDs (if the circuit was designed correctly) but GP5 will ALWAYS only be able to sink 25mA. The result is this: The two output lines will PULL HIGH but GP5 will not be able to go fully LOW and the result will be about 12mA to 15mA through each LED. If the other two outputs go HIGH, GP5 will not pull very LOW at all and only about 6-8mA will flow in each LED. The sinking line is the limitation and this type of circuit is to be avoided if you want each LED to be fully illuminated.

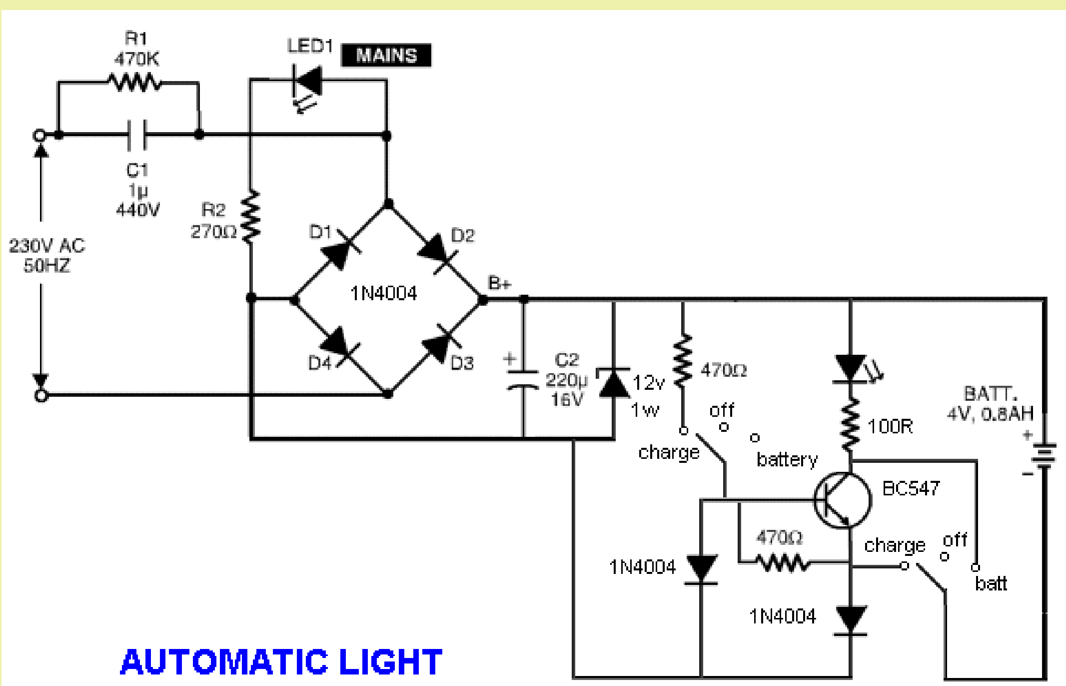


AUTOMATIC LIGHT

Here's another circuit from **Electronics For You**, an Indian publication. Many of their circuits have obviously NEVER been tested. This one is dangerous.

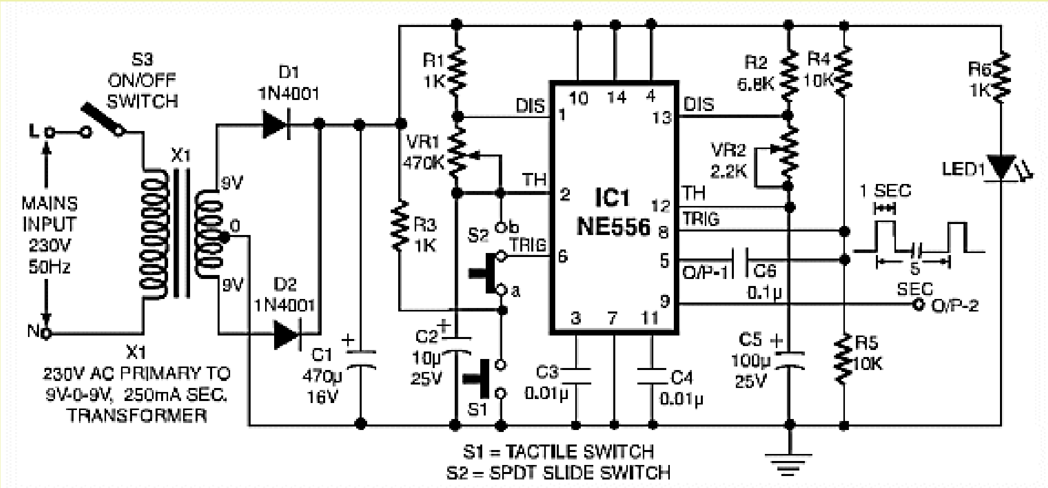


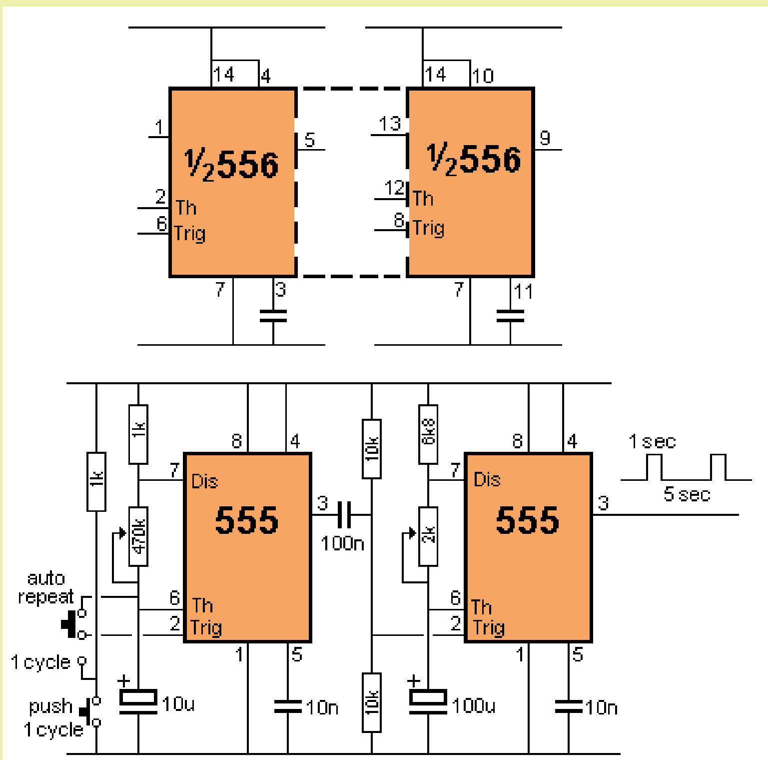
There are two major faults with the design. Can you spot them?
1. When the circuit is off, what is to stop the 220u charging to a very high voltage and blowing up? - Absolutely NOTHING!
2. The 3v6 white LEDs are being placed directly across a 4v supply without any current-limiting resistor. They will be damaged.
The circuit is so badly laid out that it is impossible to see what is happening.
The earth symbol should NOT be included. If the earth symbol is connect to the earth-lead of the power-flex and the AC lines are connected incorrectly, the project will short-circuit via via D4. This is a major mistake.
The circuit performs like this: When the AC fails, the LEDs will illuminate.
I don't like the idea of a transformerless power supply. The circuit should be connected to a 12v plug pack.
However, here are the corrections and a better layout:



PULSES

The next circuit does not have any mistakes in the design but the layout could be a lot clearer if two separate 555 blocks are used to show how it works. Most hobbyists will have 555's in their parts-box, and this is why they should be specified. We have also shown how a 556 is separated into two 555's and the pin numbering:

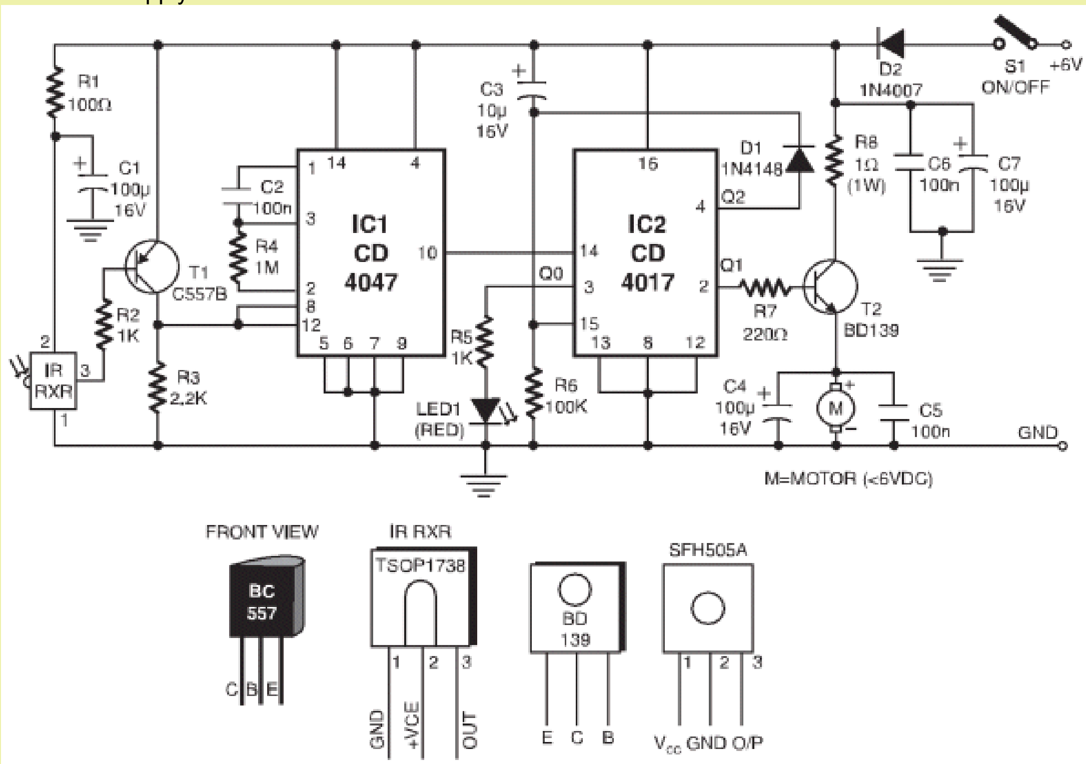


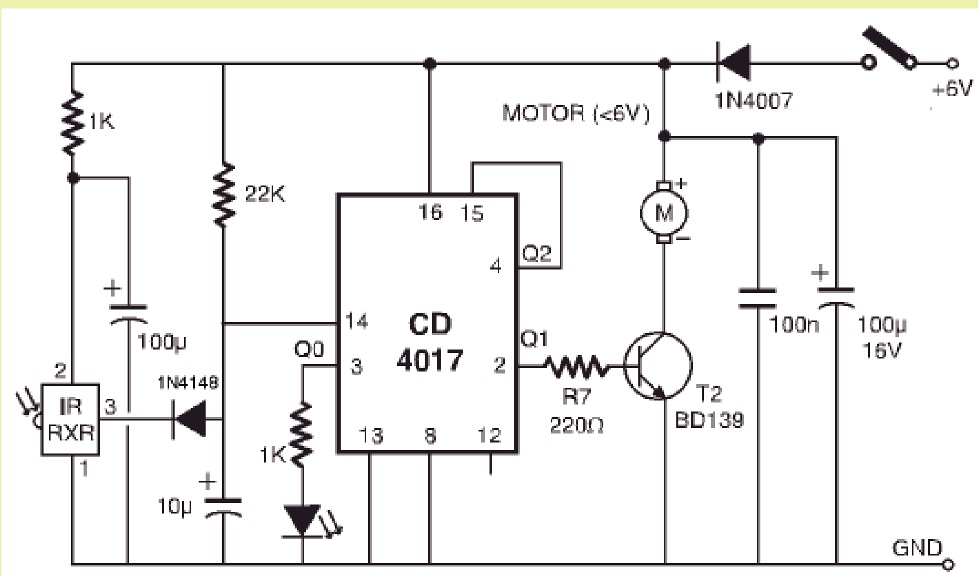


IR REMOTE ON/OFF FOR MOTOR

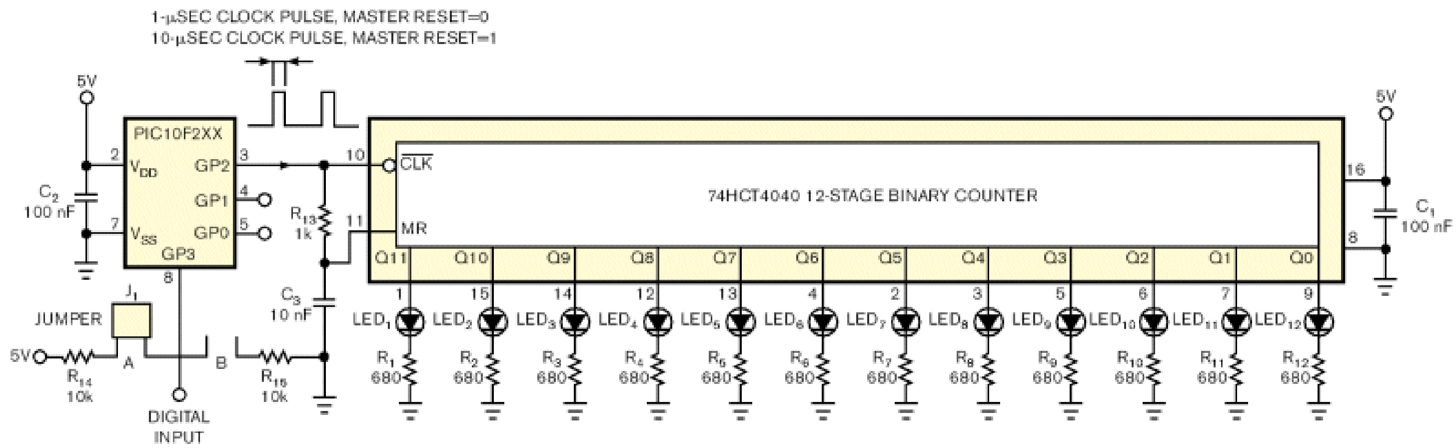
Another circuit from **Electronics For You**, the Indian publication. It uses a TV remote control to turn a motor on and off. Any button can be used to provide the action. However it is over-designed and the drive to the motor should be common-emitter.
When using an emitter-follower, the emitter voltage will be less than rail voltage by a number of factors.
There are three voltage-drops:
The output of the chip will be less than rail voltage by about 200mV. The voltage drop across the 220R resistor will be 250mV and the drop across the transistor will be base-emitter voltage plus the 200mV and 250mV, making the total about 1,100mV for 100mA current-flow.
As the current increases, this voltage-drop will increase and the combination of the voltage-drop and current-flow will heat up the transistor considerably.
By converting to a common-emitter design, the collector-emitter voltage is less than 50mV for 200mA current. This is an enormous difference.
In addition, pin 12 should never be connected to 0v rail. It is an output pin (carry out).
The circuit can be simplified as shown in the second design. The 22k and 10u form a delay circuit to slowly charge the 10u and on the rising wave-form, the 4017 clocks to the next output. The 10u and 22k also prevent the "repeat" signals from the remote control clocking the chip many times. If you keep your finger pressed, the chip clocks only once. Do not use Philips 74C4017IC. It did not work. The IR receiver used in the second

circuit had pinout: 1: output
2: earth 3: supply rail. All the IR receivers are different.

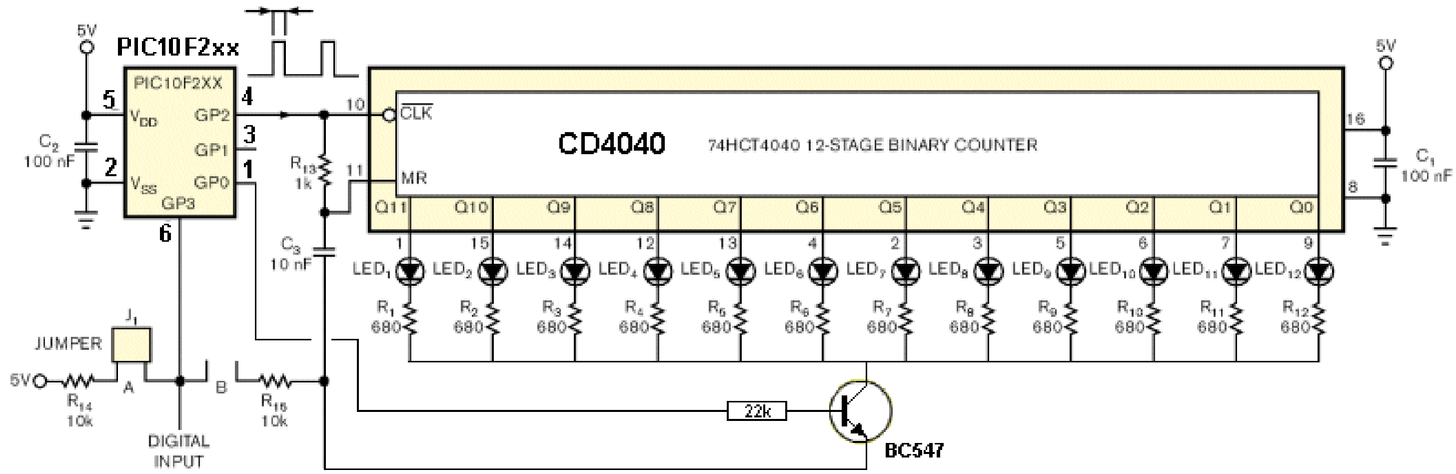




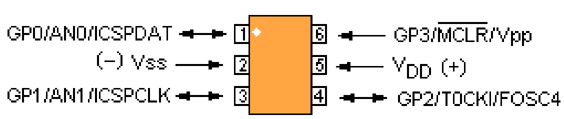
Here is a design from Electronics Design News: http://www.edn.com/article/457607-Drive_12_LEDs_with_one_I_O_line.php#id3861137-39-a The design is very good however it suffers from a lot of flickering as the 4040 counter is filled with values via a clocking action. The CD4040 chip is simply a counter (called a binary counter or divider) and for each clock cycle, the lowest output goes HIGH then LOW. With 12 outputs, it takes up to 4,096 (but more likely about 1,000) cycles to produce a result. This may take only a few milliseconds but will produce a slight flicker on the screen. This can be eliminated by connecting all the 680R current-limiting resistors to a common-emitter transistor and connecting the base of the transistor to one of the outputs of the micro. The project uses the 6pin PIC10F202 (or similar) micro with 3 in-out lines and one input line. The project also uses a clever technique of pulsing the clock line HIGH for 10uS and this will allow the reset line to rise and reset the chip. This will also clock the chip once and this has to be taken into account. The assembly code for the project is also included. The program detects either dot mode or bar mode by placing a jumper between 0v and GP3 or +5v and GP3. The circuit states a PIC10F2xx is used and the pinout is shown below with a BC547 transistor used to create "blanking." The program is not complete. It does not automatically detect a HIGH or LOW on GP3 for dot or bar mode. It does not have any value for the number of LEDs to be displayed and it does not have any instructions for the sinking transistor. However the concept can be used and it expands 3 lines of a micro to 12.



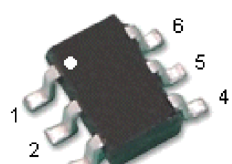
NOTE: BEFORE POWER-ON, PUT JUMPER INTO A FOR BAR-GRAPH MODE OR PUT JUMPER INTO B FOR DOT-BAR MODE.



6-Lead SOT-23



PIC10F222



PIC10F222

```
; LISTING1.ASM: dotbar/bargraph assembler routine
;-------------- define hardware ----------
#define  CLK    GPIO,2
;-------------- define variables ---------
        CBLOCK  0x08    ; beginning of RAM (PIC10F202/206)
        power           ;=1,2,...,12 numero of LED to light on
        cntL,cntH       ;low byte, high byte, for a 16 bit cnt pulses
        mode            ; 0 => dotbar mode (input GP3 with pulldown resistor)
                        ; 1 => bargraph mode (input GP3 with pullup resistor)
        ENDC
;-----------------------------------------
; HCT4040:
; if mode=0 (dotbar), then W contains numero of the LED to light on
; if mode=1 (bargraph), then W contains numbers of LEDs to light on
;-------------------------------------
HCT4040
        MOVWF   power           ; power = # of LED to light on
;first, reset the HCT4040
        BSF     CLK             ; GP2 = 1
        CALL    Delay10us       ; fill capacitor C3 until 4040=1
        BCF     CLK             ; GP2 = 0
        CALL    Delay10us       ; discharge capacitor C3 => 4040=0

;then, compute: 16 bits(cntH,cntL) = 2 ** (power - 1)
        CLRF    cntL
```

```
        CLRF    cntH
        BSF     STATUS, C
decaler
        RLF     cntL, f
        RLF     cntH, f
        DECFSZ  power, f
        GOTO    majCarry
        GOTO    sendPulses
majCarry
        MOVLW   .1
        SUBWF   mode, w         ; w = mode - 1
        BTFSC   STATUS, C       ; w < 0 ?
        NOP                     ; no, w >= 0 (i.e. mode=1, & CARRY=1)
        GOTO    decaler

sendPulses
;finally, send clock pulses
        MOVLW   .1
        GOTO    nextcnt
impulse
        BSF     CLK     ; GP2 = 1
        BCF     CLK     ; GP2 = 0 => 1 us positive clock pulse
nextcnt
        SUBWF   cntL, f         ; cntL = cntL - 1
        BTFSC   STATUS, C       ; cntL < 0 ?
        GOTO    impulse         ; no. (i.e. cntL >= 0)

        SUBWF   cntH, f         ; cntH = cntH - 1
        BTFSC   STATUS, C       ; cntH < 0 ?
        GOTO    impulse         ; no. (i.e. cntH >= 0)

        RETLW   00h
;====================================
; how to call this routine:
        MOVLW   .7      ; if dotbar, LED #7 lights on; if bargraph, 7 LEDs light on
        CALL    HCT4040 ; dotbar mode, if mode=0 (i.e. GP3 with pulldown resistor)
                        ; bargraph mode, if mode=1 (i.e. GP3 with pullup resistor)
```

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SPOT THE MISTAKES!

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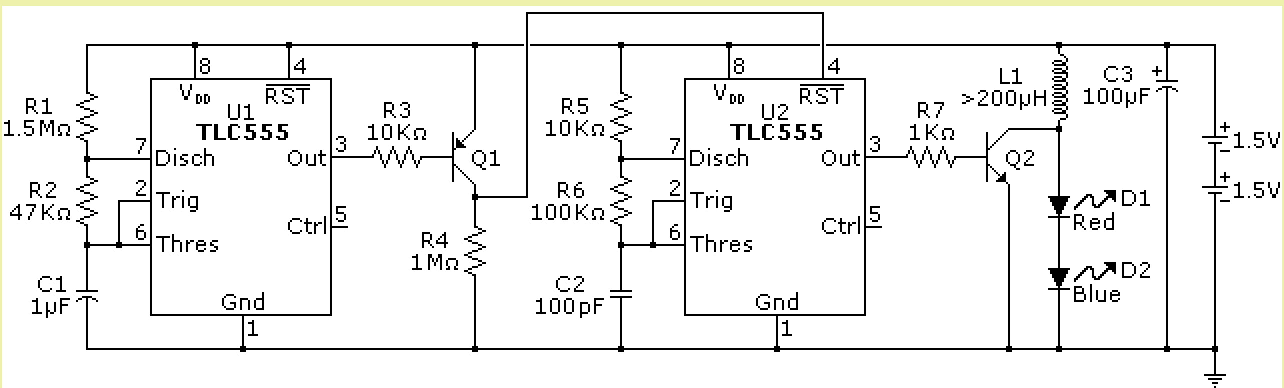
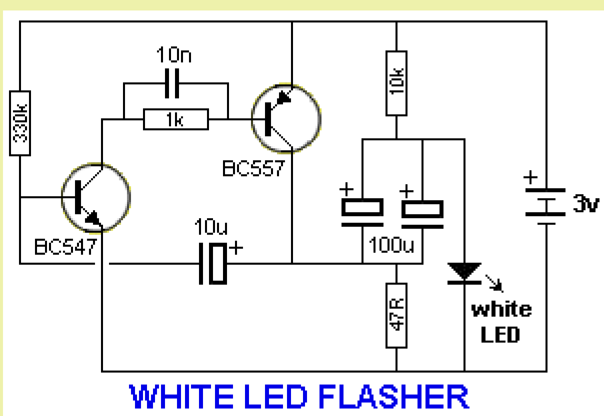
Here is a circuit that is over-designed:

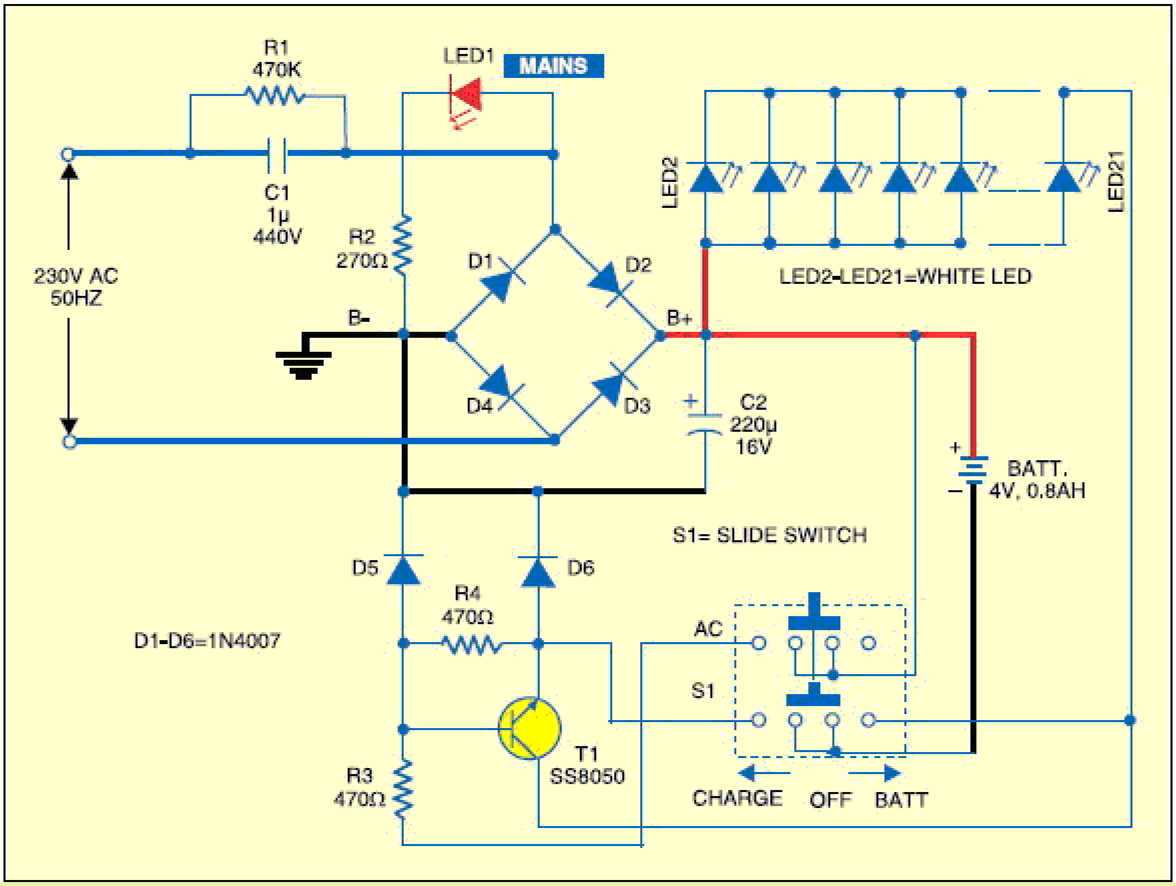


It can be simplified to this:

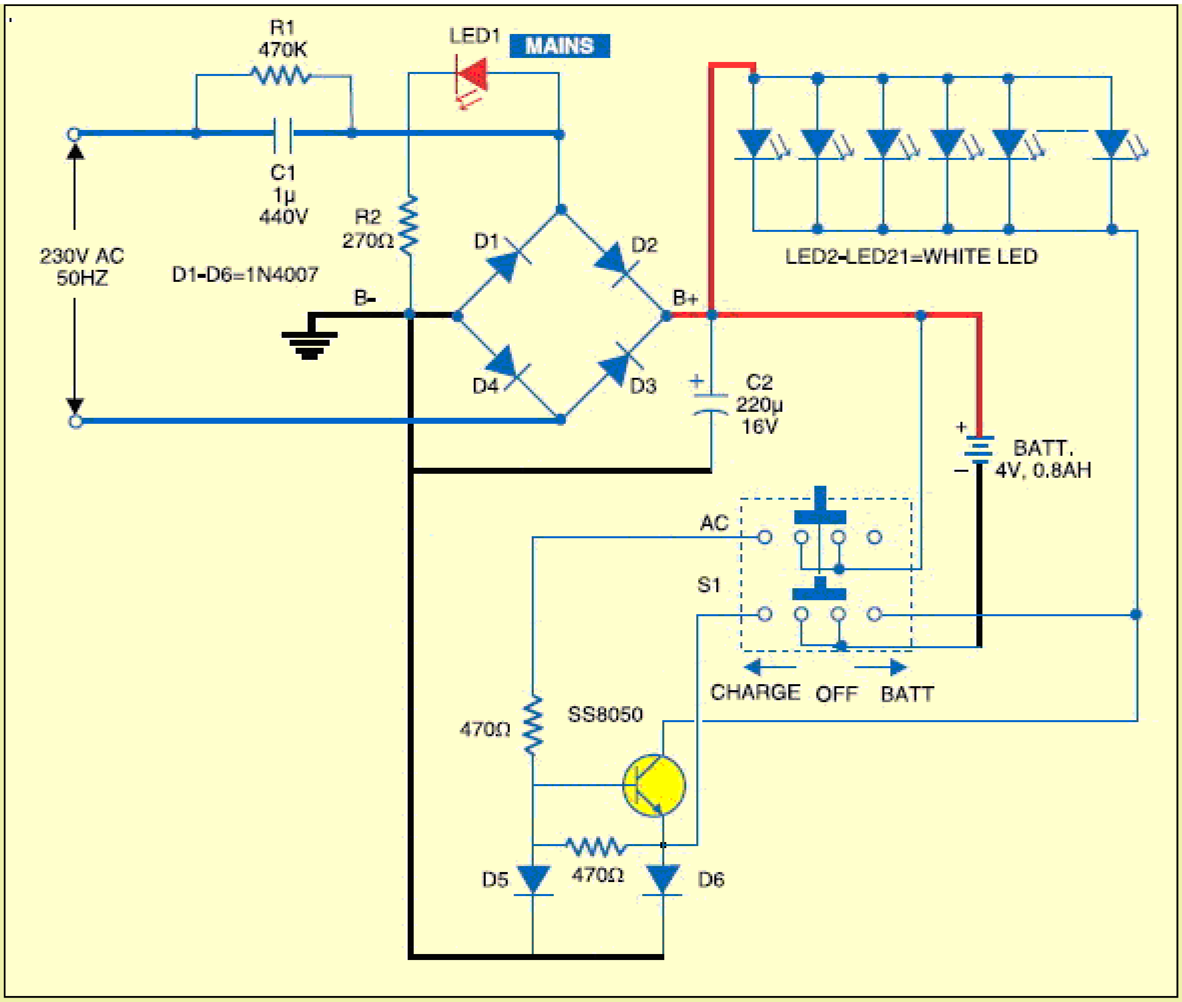


Before designing a circuit, look on the web and carry out research to see what has been done by other designers. Apart from the first circuit producing a very weak output, it uses a lot of components. The second circuit produces a very bright flash and although it is not extremely efficient in current consumption, (the 47R is placed across the supply during the short flash-period), it will work on a supply down to 2v.

Here's another circuit from **Electronics For You**, an Indian Magazine:



There are a number of mistakes on the circuit. The main problem is the layout. It is not clear what the transistor is doing.
We will rearrange the circuit and things will become clearer.

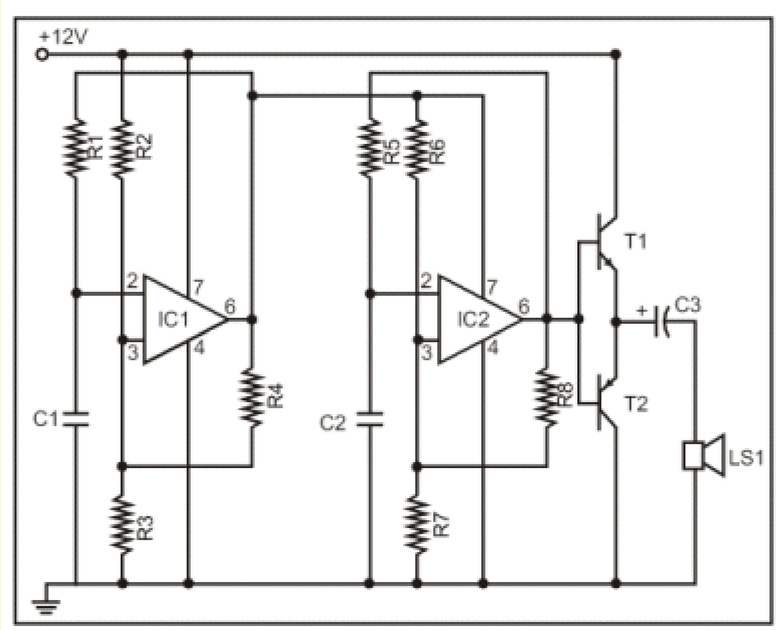


Here are the faults:
1. LEDs should not be connected across each other as each LED creates a slightly different voltage across it when it is working - called the "characteristic voltage". To put 21 LEDs in parallel will give very poor results.
2. There is no such thing as a 4v battery. All wet cells are 2.1v and you are connecting 4.2v directly across LEDs that require an exact 3.6v max for white LEDs. At 4.2v they will be instantly damaged.
3. When the switch is "OFF" the output of the transformerless power supply goes though the LEDs and through the collector-emitter of the transistor.
The transistor is not turned on but the output of the power supply will rise to 315v if no load is on the output. As the voltage rises, the transistor will zener at the maximum voltage it will withstand. This could be 25v, 45v, 65v or even higher.
It will definitely zener AT SOME VOLTAGE and the LEDs will illuminate.
That means the circuit does not have an OFF position.
If the transistor zeners at 65v, the 220u 16v electrolytic will have nearly 70v across it and it will be damaged.
4. The transistor is placed in a position of being damaged.
5. The 1u capacitor on the input will allow 150mA and when this is divided between 21 LEDs, each will get 7mA. But some will get more and some will get none as they are in parallel (across each other).
6. There is no safety resistor on the input to prevent surges entering the LEDs if the circuit is turned on when the supply is at a peak. The instantaneous current though the 1u is MANY AMPS. It's exactly the same current that is available from a fully-charged capacitor, when the leads are shorted together. That's why they use capacitors for spot-welding, due to the very high current they can provide.

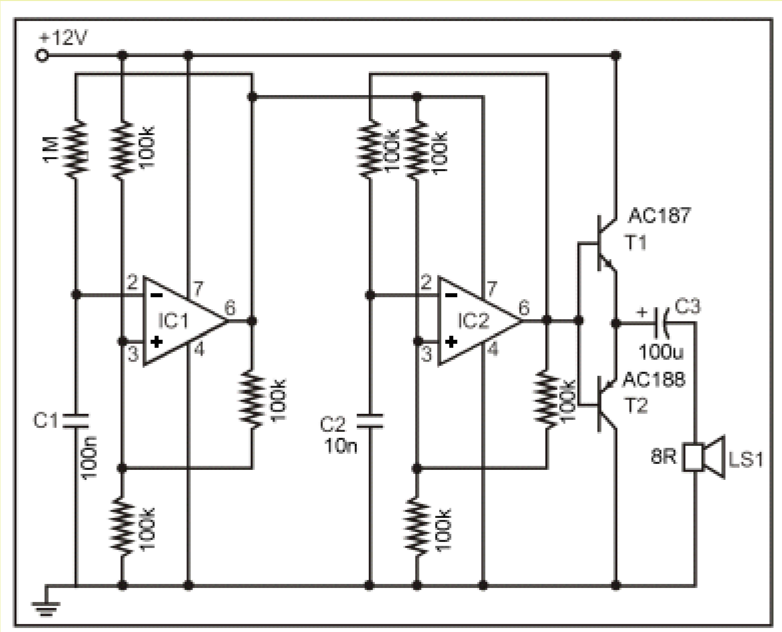
This is a very badly designed circuit and the layout of the original circuit makes it very difficult to see the faults.
That's why it is so important to layout a circuit correctly.
And it's critical to test a circuit before putting it in a magazine that has over ONE MILLION READERS.

Here is a typical circuit without any component values. I am sick of seeing circuit diagrams like this.
They are obviously produced by a non-engineer. To an electronics engineer, a circuit diagram is a complete picture and it is actually more than a blur.
An engineer can see the circuit working when he knows the value of the components.

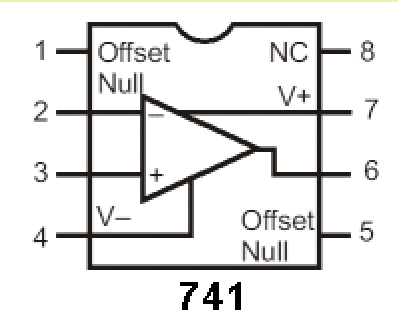
The circuit uses AC187, AC188 transistors in the output. These are germanium types and went out of production 20 years ago. This circuit was presented in an Indian magazine. The output will draw nearly 1amp but the transistors are only designed for 300mA. You can trust the Indians to get things wrong.



Circuit diagram of the Electronic Siren



Circuit diagram of the Electronic Siren

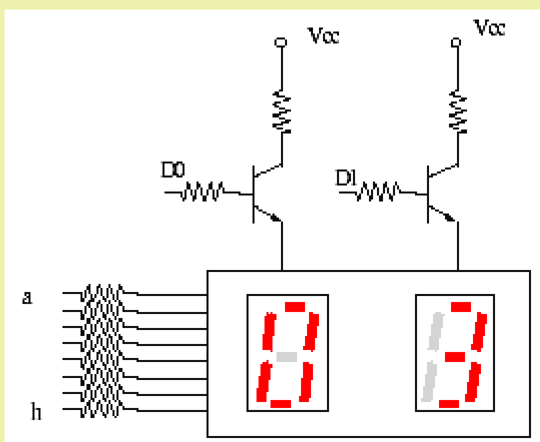


When the component values on the inverting and non-inverting inputs are included on the diagram, we can see how the circuit works.

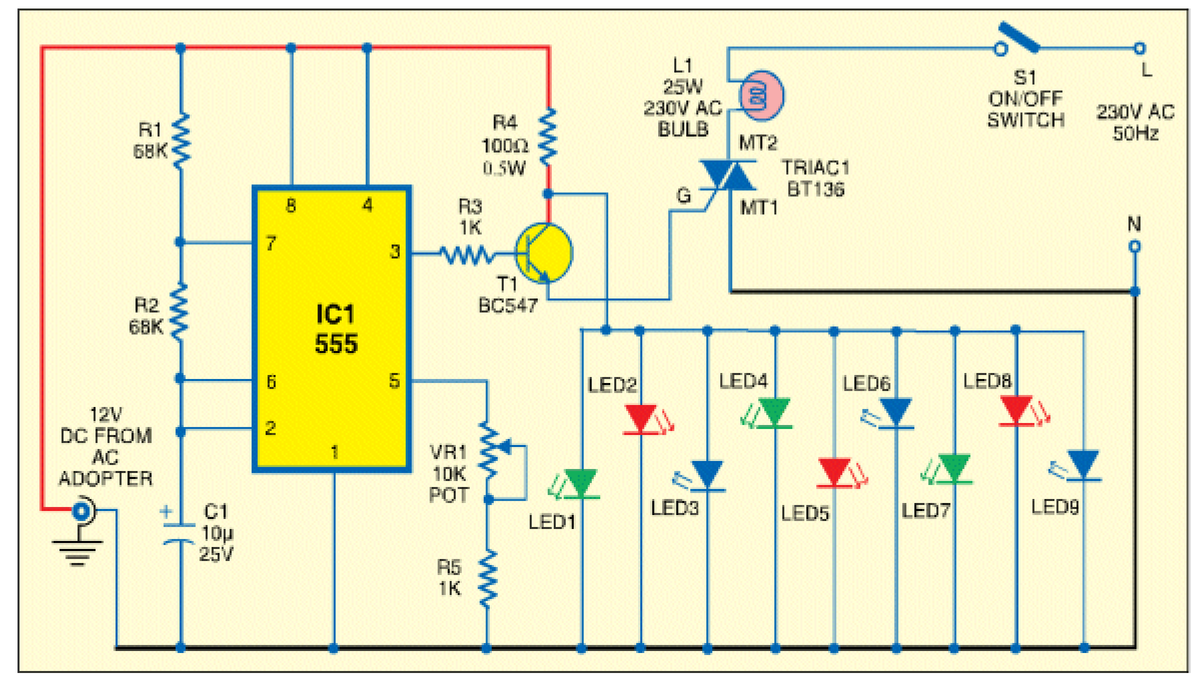
The principle of an op-amp is to provide a very high gain. This means a small change in either input produces an

almost full rail swing on the output.
The circuit starts to work like this.
As soon as you put a slight voltage on the "+" input, the output goes full HIGH.
The two 100k resistors on the "+" makes the output go full HIGH.
Now we connect a resistor from the output to "+" and this makes no difference. The output remains full HIGH.
Now we put a resistor from output to "-."
If the "-" input is slightly higher than "+" the output goes LOW. This is what happens. The output voltage drops until the "-" input is slightly lower than the "+" input and that's why the output falls until its voltage is equal to the "+" input.
Now we connect a capacitor to the "-" input.
It does not matter if we add the capacitor later or turn the circuit on with the capacitor fitted.
The voltage on the "-" input will be lower than the "+" input and this will start the circuit oscillating.
This is how it oscillates:
Because the "-" input is lower than the "+" input, the output rises towards the positive rail and this begins to charge the capacitor.
The voltage on the "-" input can rise higher than the "+" input and when it is about 15mV higher, the output drops towards the 0v rail.
This reduces the voltage on the "+"input and the capacitor has to discharge a considerable amount before it is lower than the "+" rail. (Actually before the "+" input is higher than the "-" input).
The voltage on the "+" input is rising and falling by about 30% of rail voltage and this is the amount the capacitor has to charge and discharge for the circuit to work.
But it is only when the component values and "+" and "-" are included on the circuit that you can see how it works.

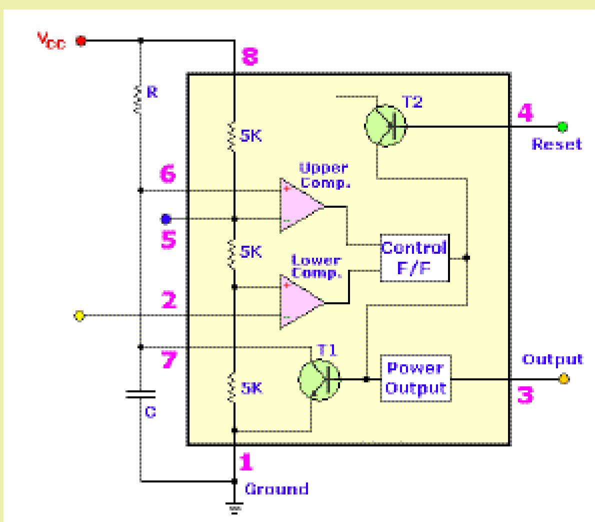
This design has mistakes. The resistor in the collector and the resistor in the bases are not needed.
Firstly the resistor in the collector. When one segment is illuminated, a small voltage will develop across this resistor. When two segments are illuminated, the voltage will increase. When seven segments are illuminated the voltage will be even higher and all the segments will become dull.
The base resistors are not needed. A base resistor is only needed when the emitter is fixed to the 0v rail. When a transistor is in emitter-follower mode (common-collector mode) as shown below, the voltage and current delivered to the base will pull the transistor fully to the positive rail. If the load in the emitter-line does not allow the transistor to rise fully, you need to deliver more current to the base or use a Darlington transistor.
The circuit should be designed so the transistor rises fully and a base resistor is not needed.
The current limiting resistors in the circuit are the 7 resistors at "a" to "h." These are the only resistors you need. You don't need the collector or base resistors.



Here is another disaster from **Electronics For You**:

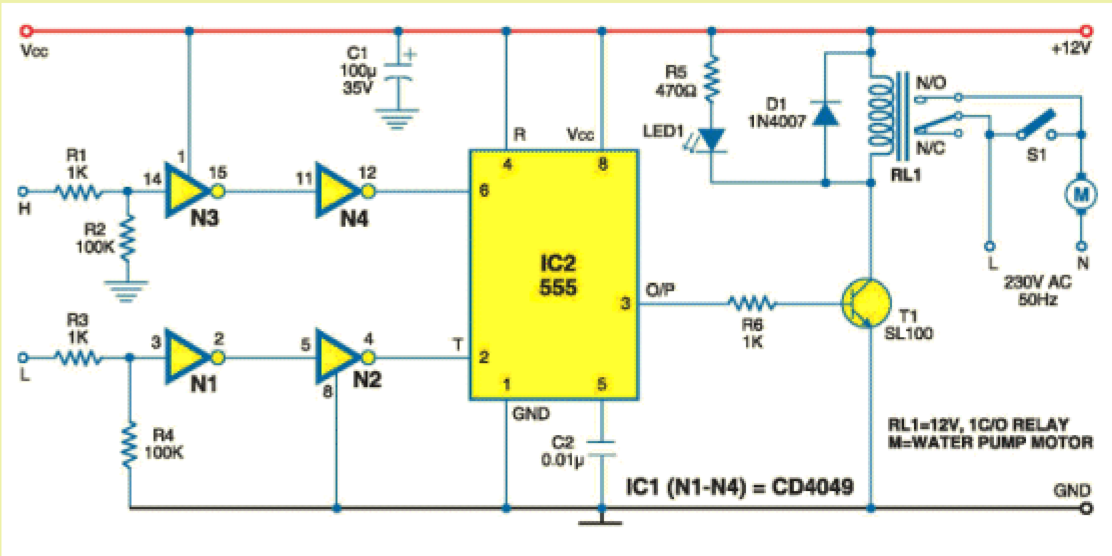


I told the CEO of **Electronics For You**, Ramesh Chopra, to send me details of projects before they are published, but I did not get a reply. Look at the circuit above. The Neutral is connected to the earth on the project.
But you cannot guarantee a power point or an extension lead is connected correctly and the Active and Neutral can be swapped due to incorrect wiring of the power outlet or the power-cord.
This means the Active will get connected to the Earth via the project and blow the fuse.
The second major fault is the LEDs are connected in parallel. Each LED has a different characteristic voltage and they cannot be connected like this.
I have already had this argument with another writer for **Electronics For You** and he said "his white LEDs dropped 2.2v" Show me a white LED that drops 2.2v when about 17mA is flowing??
It does not matter if a writer has an odd batch of LEDs, the object of a magazine is to deliver correct information to its readers and **Electronics For You** is certainly not living up to this requirement.
On top of this, the transistor is not needed, the LEDs could be driven from the output of the 555 as sets of 3 in series with a dropper resistor.
Again, no-one has tested the circuit and no-one in the technical department of **Electronics For You** knows the slightest about technology or safety.

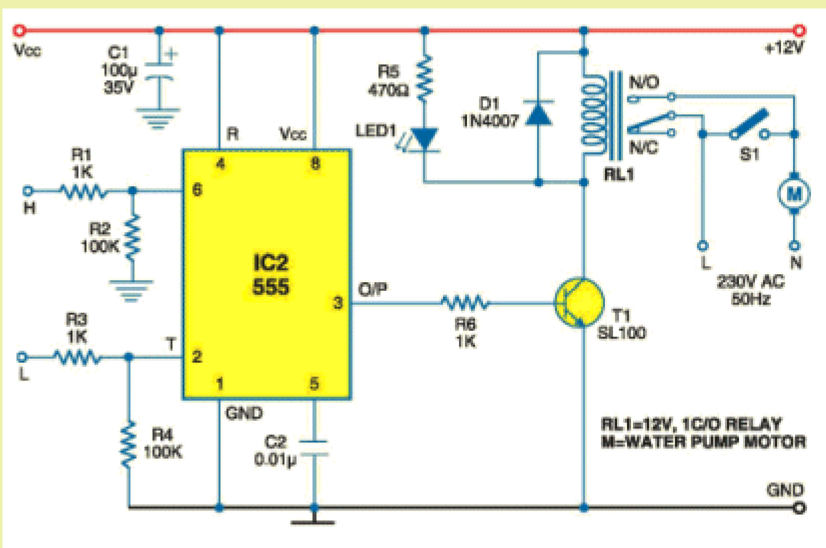


And the 1k on pin 5 is not needed. The diagram above shows the connection of pin 5 to one of the comparators and three 5k resistors. Adding a 1k to the 10k pot on pin 5 is not going to have any affect at all. As I have said before, look at each component and ask yourself: "Is this needed?" Adjusting the 555 frequency via pin 5 is very unusual, normally the timing resistor between pins 6&7 is adjusted, and two components could be removed.

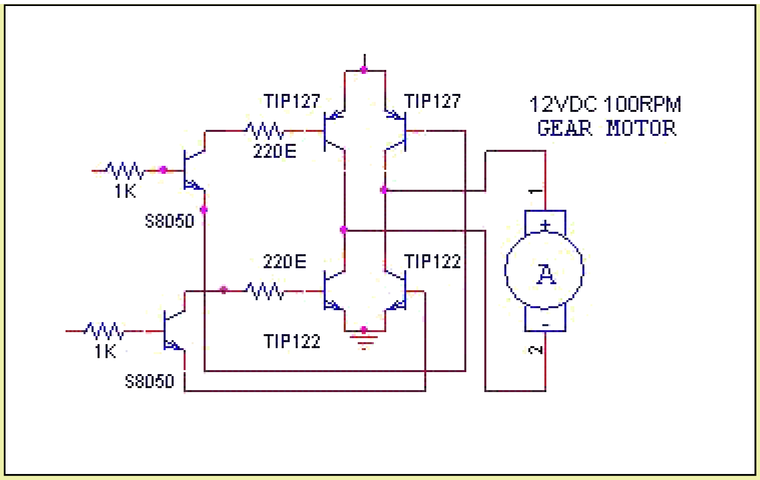
Another circuit from **Electronics For You**:
The circuit detects the level of water via three probes in a vessel. The probes have different lengths and the resistance of the water causes the 555 to turn on the relay. The point of the discussion is this: The 100k resistors on the input reduce the impedance of the inputs to 100k and this means the inputs of a 555 can be used directly. They have an input impedance higher than 100k (about 500k). The CMOS 4049 is not needed. Depending on the conductivity of the water, the probes can be made larger or closer together or the input resistance to the 555 can be increased to suit the new circuit.
As I have said before. Ask yourself this simple question: Is each and every component needed?
Try removing each item and see if the circuit works are required. Otherwise someone else is going to simplify your design and put you out of business.



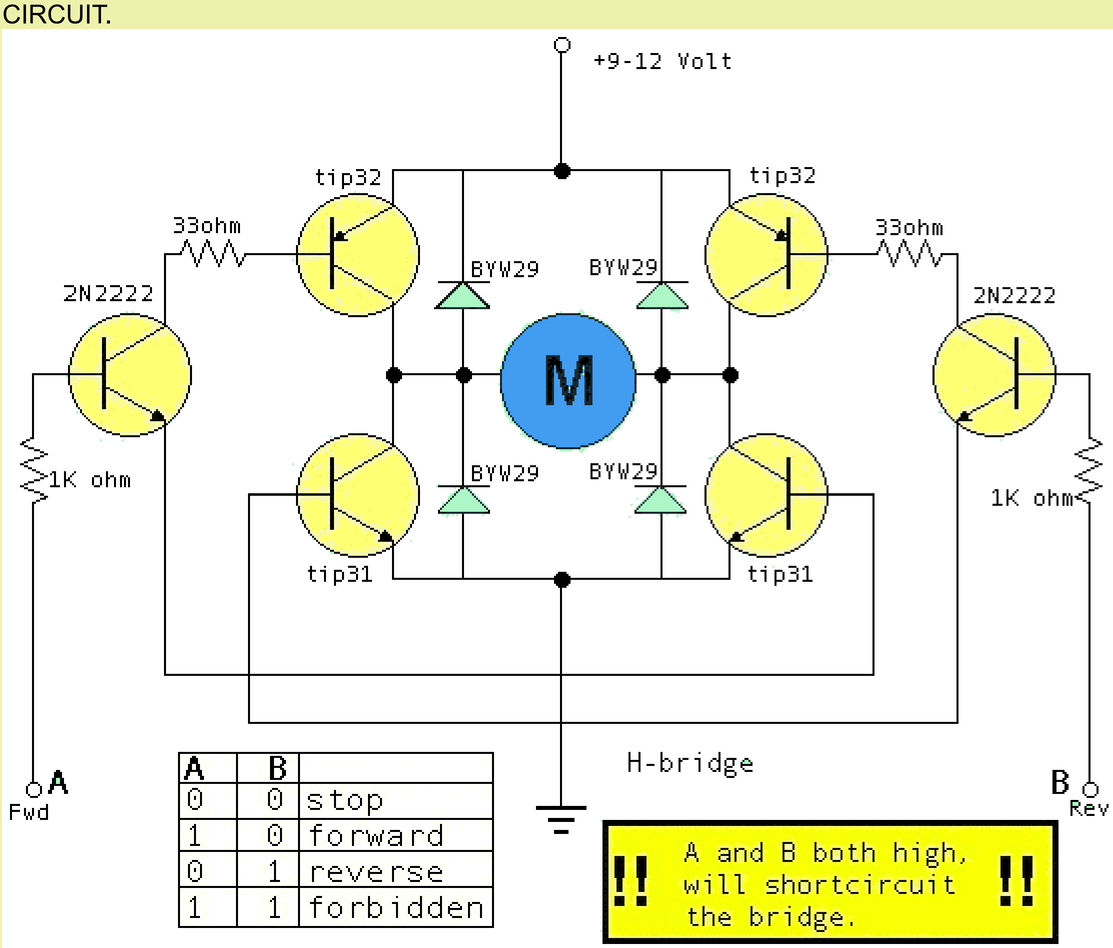
Here is the simplified circuit:



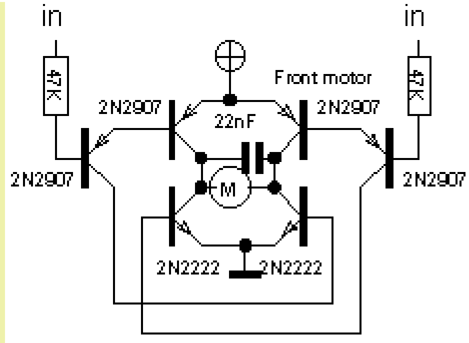
More from **CircuitsToday.com**:
Here is an H-Bridge that will not work. The lower left-hand transistor in the H-Bridge will not turn on:



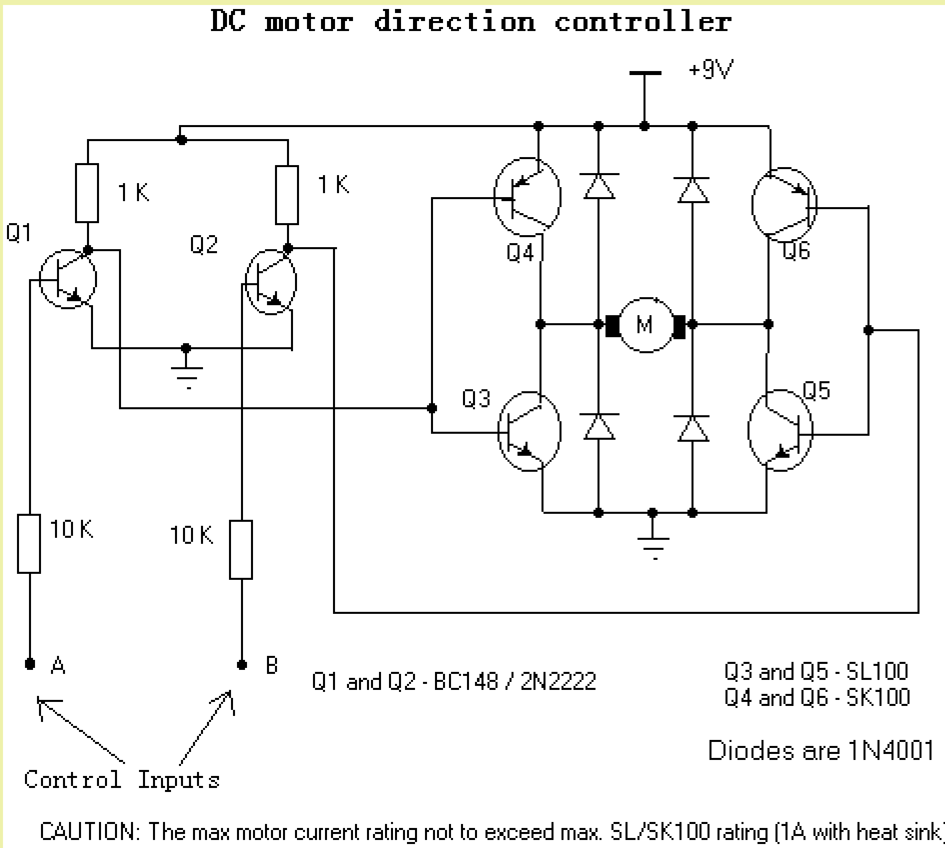
The next circuit shows how the 4 transistors in the bridge must be cross-coupled so that diagonally-opposite transistors are activated to turn the motor in either forward or reverse direction. But in the circuit below BOTH inputs A and B must not be HIGH at the same time or the 4 transistors in the bridge will be turned on and create a SHORT-CIRCUIT.



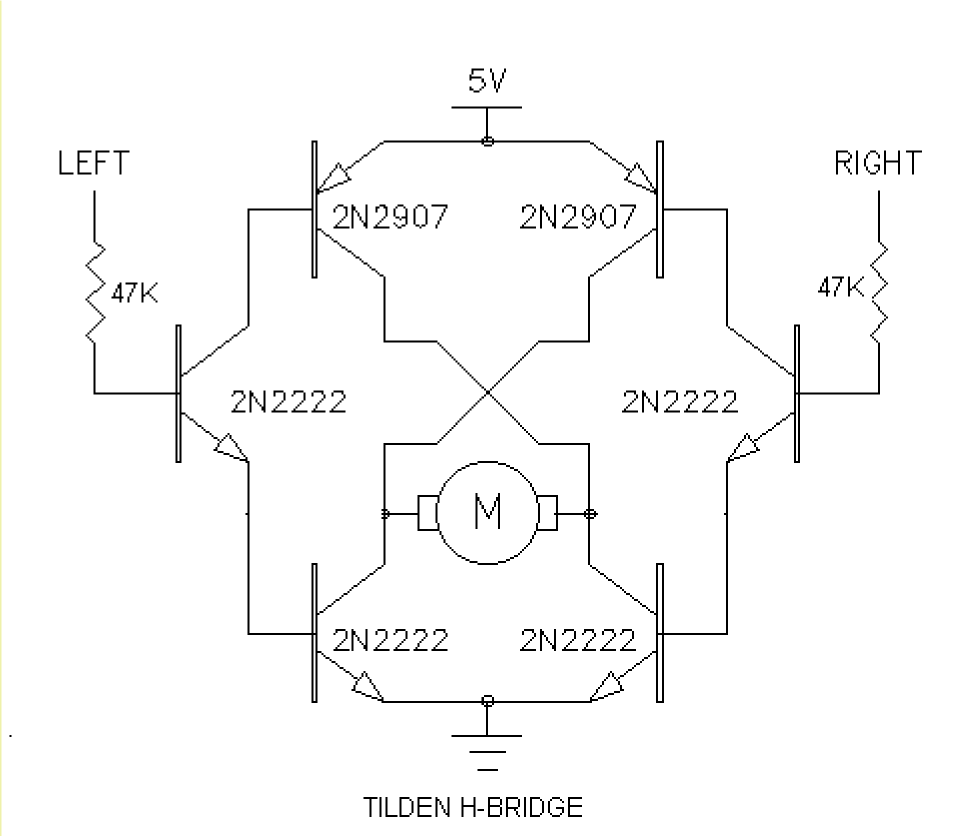
The following circuit uses PNP transistors to drive the bridge and both inputs must not be LOW as this will turn on all 4 transistors in the bridge and create a SHORT-CIRCUIT:



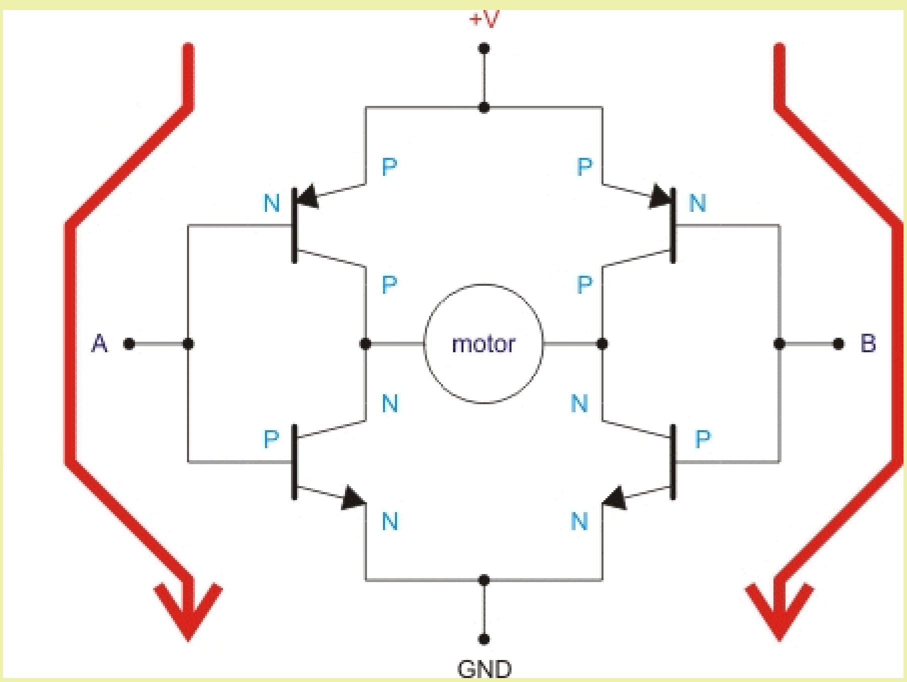
The following circuit creates a short-circuit across the power supply each time the input changes from one state to the other. One reader created the circuit with MOSFETS and they were constantly being destroyed in the microsecond that the transfer took place from forward to reverse or reverse to forward.



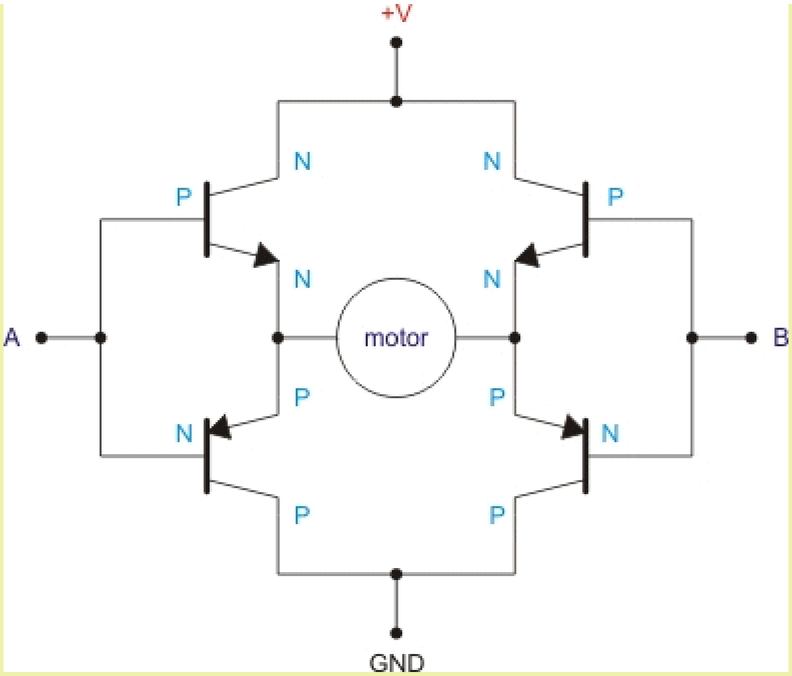
The following circuit is a disaster. When either the left or right section is turned on, the voltage-drop across the junctions of the three transistors is less than 2v. A very high current will flow via the base-emitter junctions of the top and bottom transistors (and the collector-emitter of the middle transistor) and they will be destroyed:



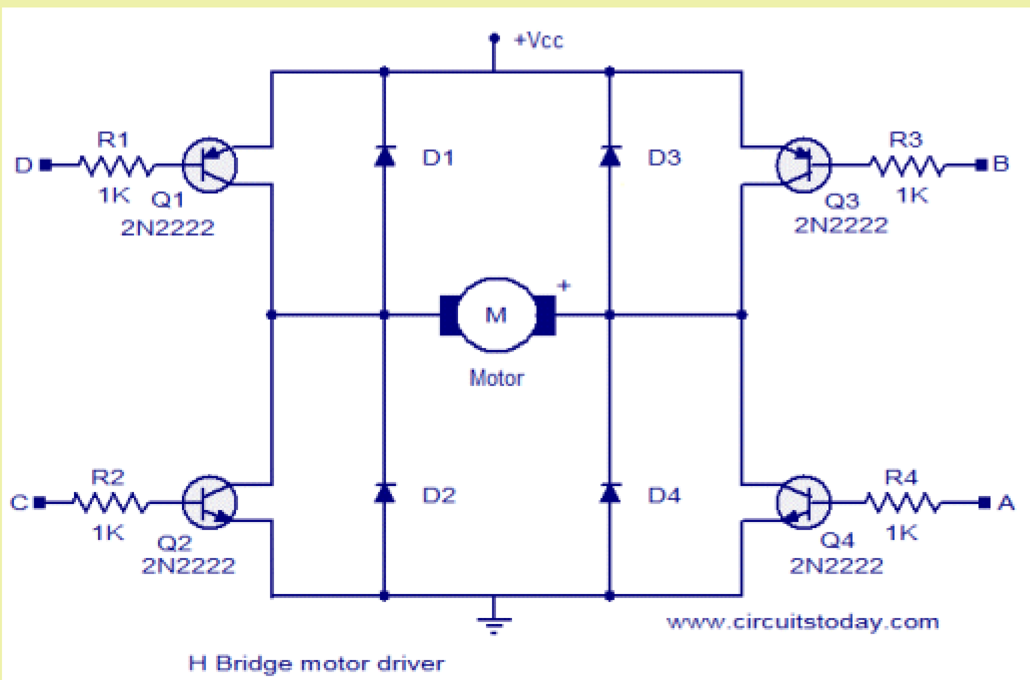
The following circuit shows a high current flowing through the PN junctions of the transistors (follow the arrows on the transistors to see what we mean) and this type of layout is to be avoided:



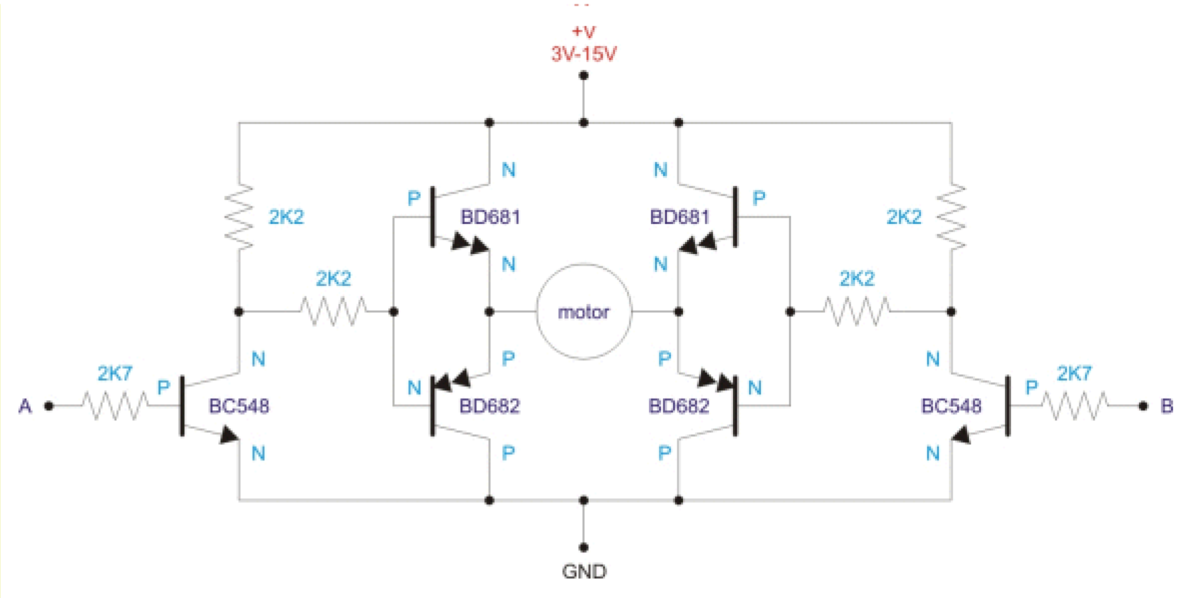
The following circuit shows the correct placement of the transistors to prevent a SHORT CIRCUIT:



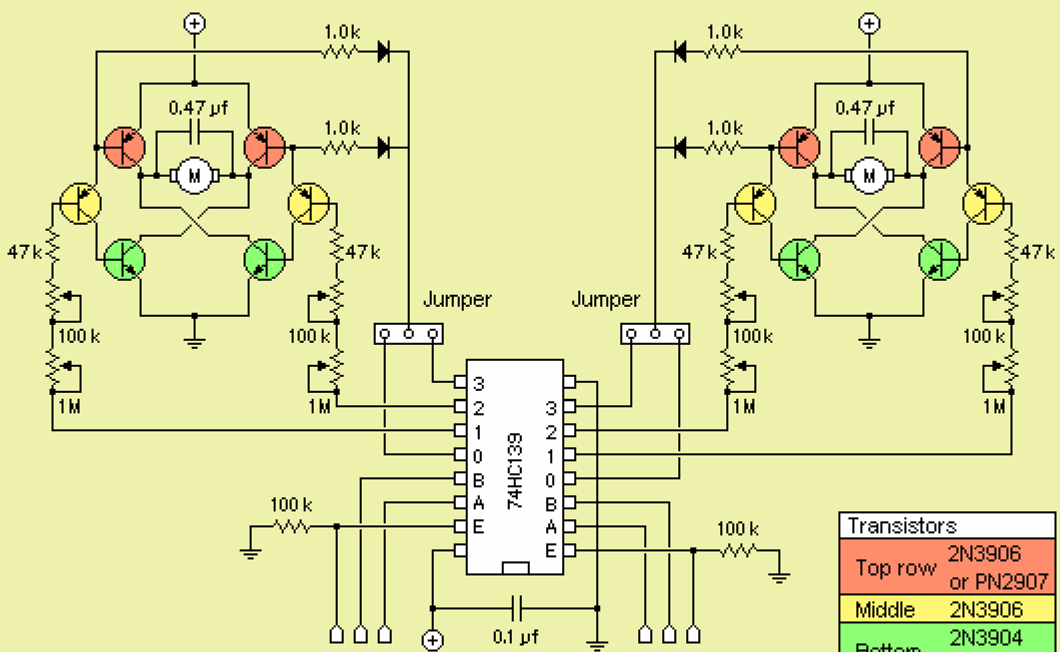
The following circuit shows 4 transistors in an H-Bridge. The designer says the circuit will deliver 800mA but the 1k resistors on the base will not saturate the 2N2222 transistor sufficiently to deliver this current. In addition, a motor takes 2-5 times more current when starting and that's why the transistors must be able to deliver a very high current.



The following circuit solves the problems mentioned above and the control voltage can be lower than the supply to the motor. To understand what we mean you will have to look on the web for H-bridge designs. This article only highlights faulty H-bridge circuits. The double arrow on the transistors indicates a Darlington Transistor. The 2k2 resistors can be reduced to 100R to increase the drive-current to the motor.



The following circuit will create a short-circuit across the power supply when any of the inputs are active.
Take the left three transistors. When the input is LOW, the middle transistor will turn on and produce a voltage of about 0.2v between the emitter and collector leads. This will allow current to flow and turn on the top transistor and also the lower transistor. Both these transistors will produce a maximum of 0.7v between the base and emitter leads. Thus we have 3 junctions across the power supply and the junctions are trying to drop the power supply to: 0.2v + 0.7v + 0.7v . If the power supply is higher than this voltage, an enormous current will flow and the transistors will be destroyed.
Obviously the circuit has never been tested.



Dual non-shorting H-bridge with brake

Based on a design by Mark Tilden with modifications suggested by Wilf Rigter.

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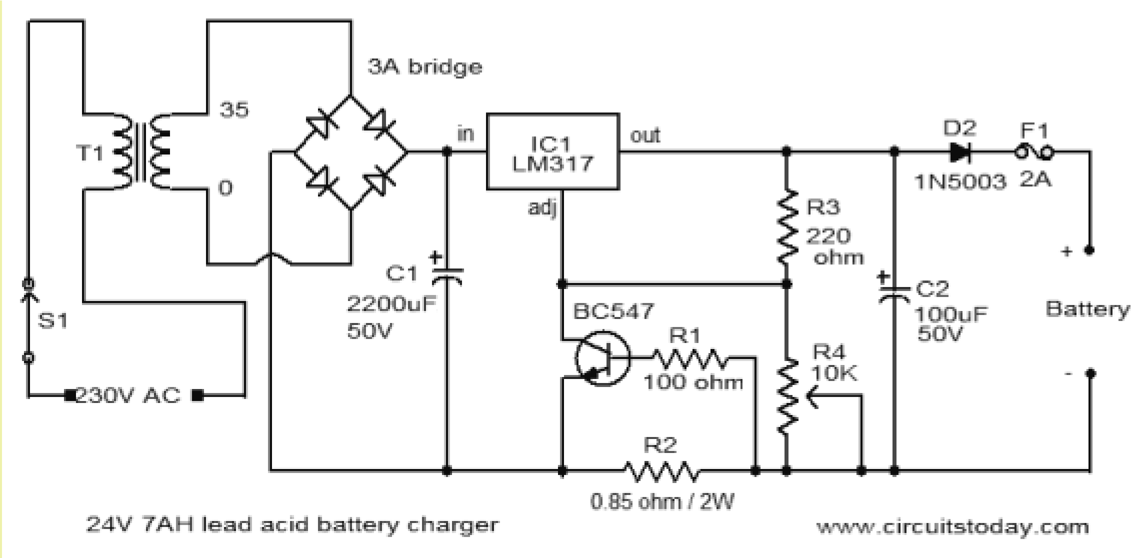
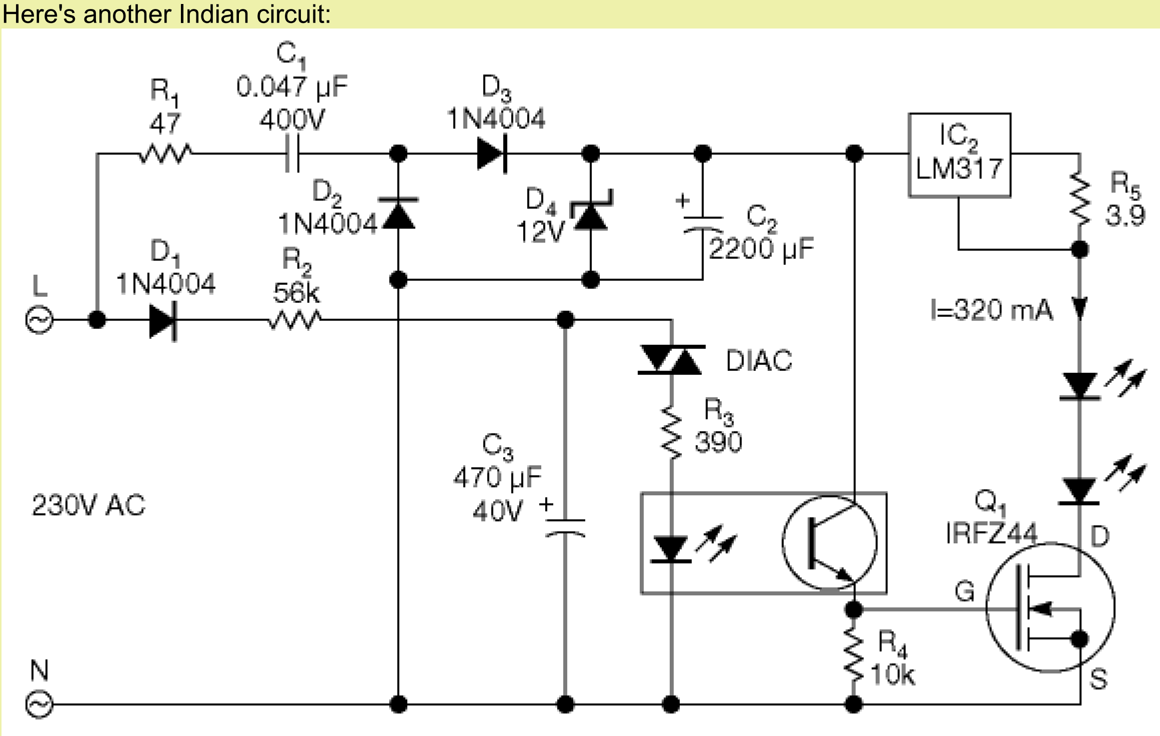
There is nothing really faulty with the following circuit except the fact that the output of the bridge will be 35 x 1.4 = 50v plus about 7v (to allow for voltage-drop due to a term called "regulation") making the output voltage 35v AC. This means about 25v will be dropped across the regulator and if the max current is 800mA, the wattage lost in the regulator will be 20 watts. This makes the circuit about 50% efficient and the regulator will need to be mounted on a large heatsink. The aim with all circuits similar to this is to keep the input voltage as low as possible to reduce the heat generated by the regulating components.

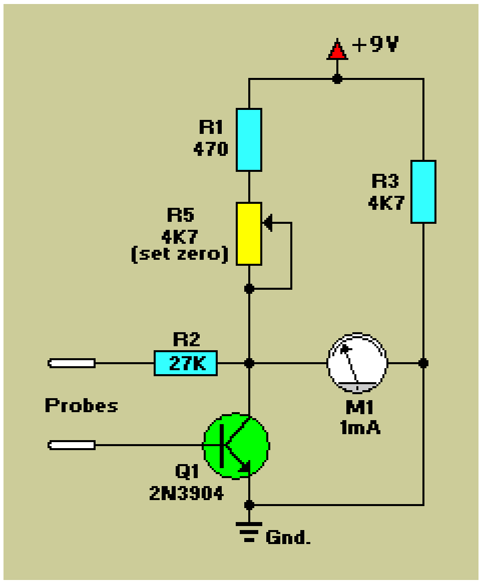


Here's another Indian circuit:

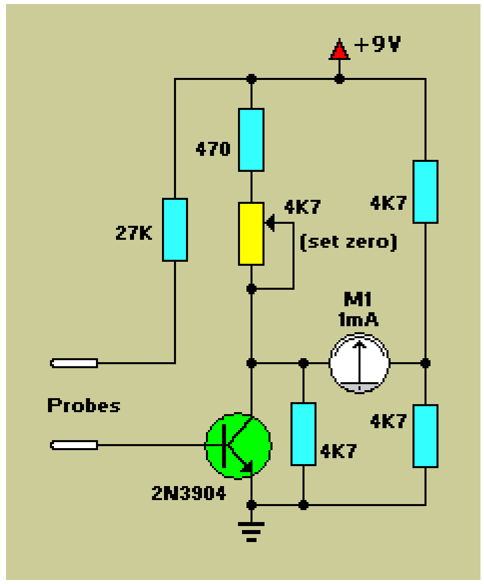


The circuit flashes LEDs and was presented in Electronics Design News. The circuit is extremely complex for such a simple task.
The 0.047u capacitor will deliver less than 2mA RMS (5mA peak) in half-wave and it will take a long time to store enough energy in the 2200u to produce a flash. No LEDs will allow 320mA to flow without being damaged and a current limiting resistor is essential.

This circuit is a simple Wheatstone bridge "lie-detector".
A milliammeter with its zero at the centre of the scale is connected across the bridge. It serves as a bridge-imbalance detector. Large bare copper boards can be used to make suitable probes.
The probes should be taped or strapped directly to the skin on the subject's hand or arm, separated by at least 5cm.
When the subject is relaxed and his or her skin resistance reaches a stable value, adjust potentiometer R5 to obtain a null on milliammeter M1. The subject can then be questioned about the truth or falsity of emotionally loaded or embarrassing subject.
The subject's skin resistance will change in response to questions if they are phrased correctly. The bridge will be unbalanced if the subject reacts emotionally to the questions.



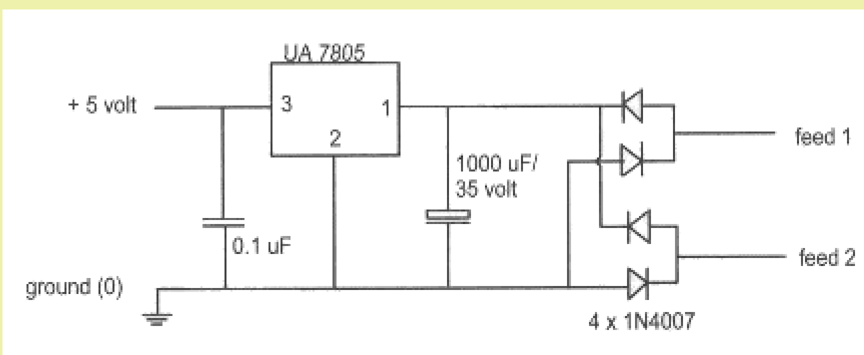
Simple Lie-Detector circuit is suitable for experiments and fun.



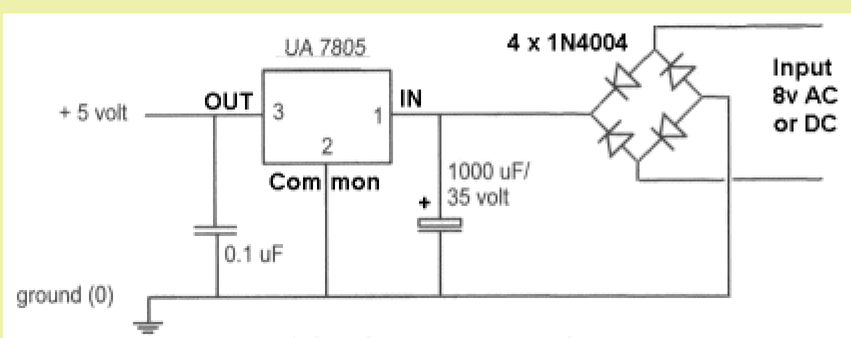
The circuit above is not a Wheatstone bridge as a bridge must have 4 resistors and a change in any resistance will deflect the needle either up-scale or down-scale.
The second diagram is a bridge arrangement and the resistor across the transistor can be removed and the pot adjusted when the probes are in place.

A simple mistake of leaving out a resistor in the bridge can render the circuit non-functional. That's why you must build every circuit before putting it on the web.

Here's a circuit from an electronics book. It doesn't have a fault but the circuit is not instantly recognisable:



Stabilized 5V power supply.

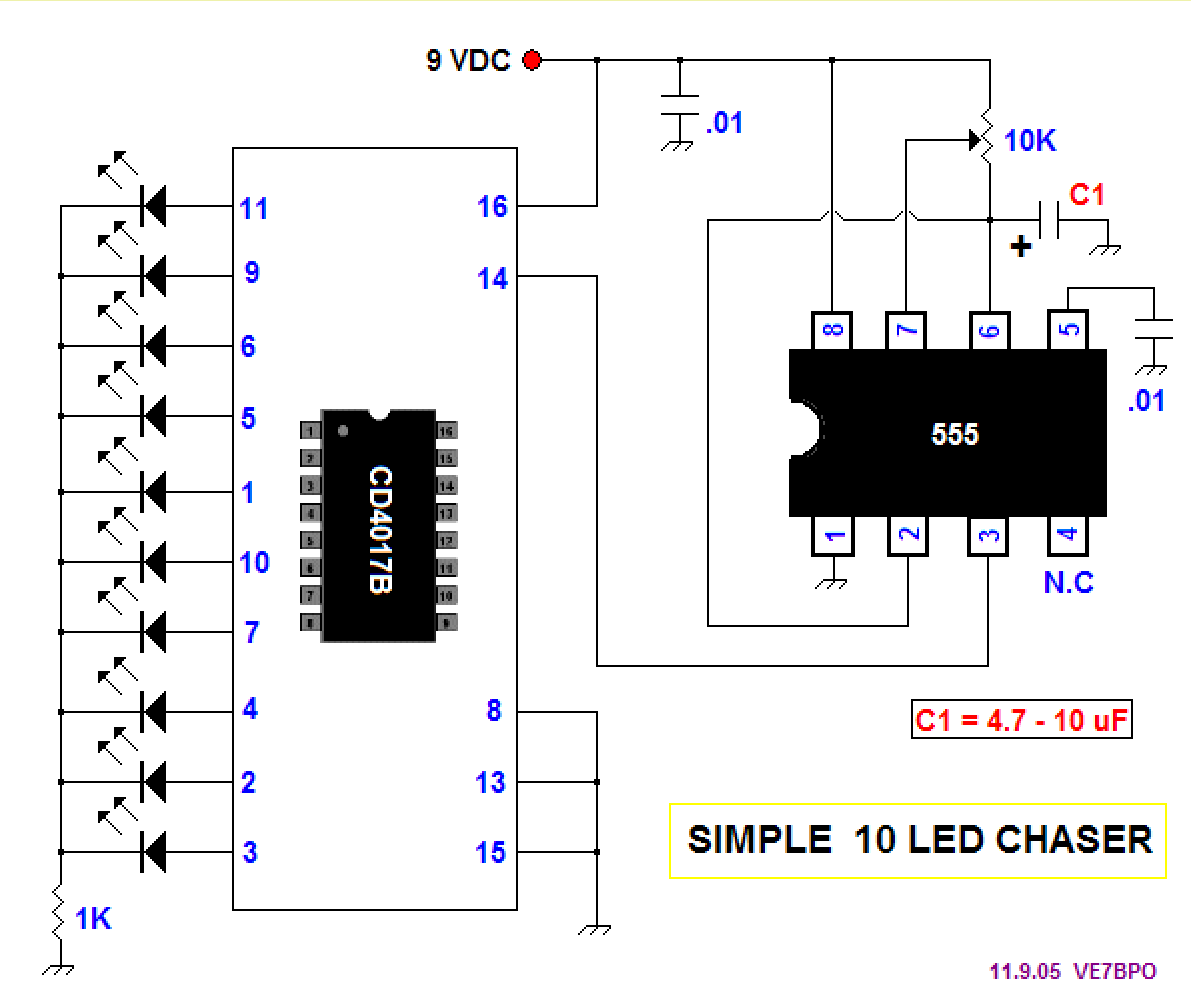


Stabilized 5V power supply.

In the second circuit, the 4 diodes are easily recognised as a bridge and the pins on the regulator are marked as IN Common OUT. The circuit does not need 4 x 1,000v 1N4007 diodes.

100v diodes are sufficient but most stores only stock 400v 1N4004 diodes.

There are 3 problems with this circuit:

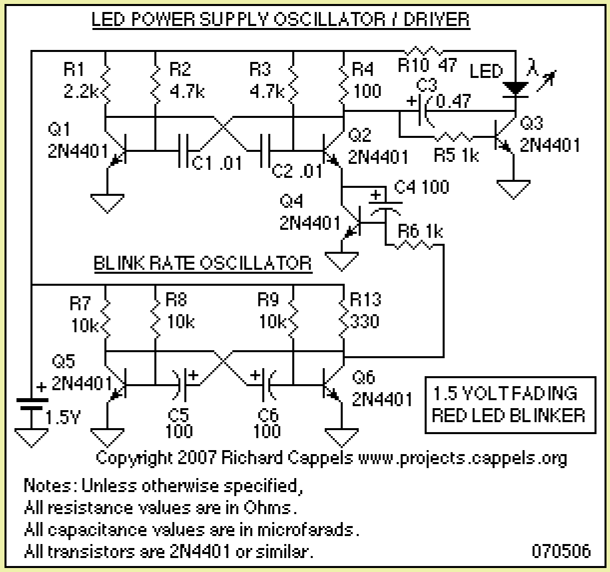


1. There is no "stop resistor" on the 10k pot.
2. Pin 4 of the 555 is not connected.
3. The 1k resistor is too high.

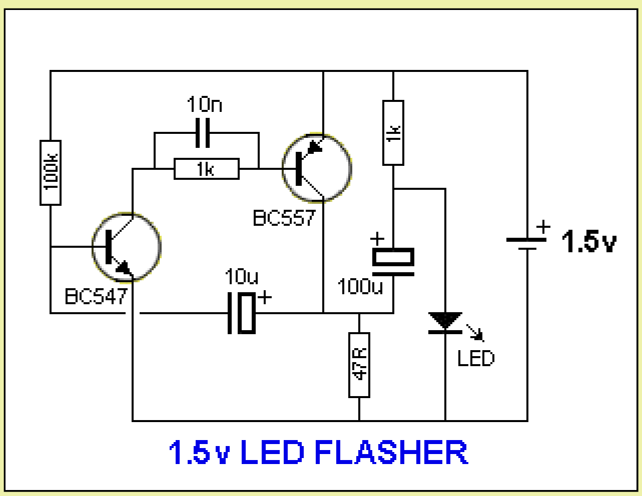
At first glance I missed the fact that no stop resistor has been included because the diagram is not a SCHEMATIC.
It is a LAYOUT DIAGRAM and you cannot instantly see what the circuit is doing.
That's why a layout diagram is so dangerous. It does not allow you to become instantly aware of any mistakes.
If the 10k pot is turned clockwise, pin 7 will be connected to the 9v supply and the 555 will be immediately damaged.
A 1k resistor between the end of the pot and the 9v rail is needed.
The reset pin (pin 4) of the 555 is internally pulled HIGH via a 100k resistor but this pin should not be left unconnected as it is a bad policy to leave reset lines floating. Some chips have very high impedance reset lines and this will cause erratic behaviour.
The 1k current limit resistor on the cathode leads of the LEDs can be decreased to 470R to allow the maximum current to flow.
At 1k the current will be about 7mA. At 470R the current will be about 14mA.
The 10n on the supply and pin 5 will have no effect on the operation of the circuit and are not needed.

This is an example of over-design:
The following 6 transistor circuit flashes a red LED on a 1.5v supply. The first two transistors form a 15kHz oscillator to charge a 0.47u electrolytic with the aid of Q3. This circuit has been described in our "200 Transistor Circuits" eBook. The low-frequency oscillator made up of Q5 and Q6 turns the first oscillator ON and OFF to blink the LED. But the circuit is far too complex.

Before designing any circuit, you need to research circuits that have already been produced as you may find someone has already designed something much simpler.
This reminds me of the original Garrard turntable with 245 components to lift the arm onto the record and return it to the rest position at the end of play. Then someone came along with an identical turntable using just 15 components.

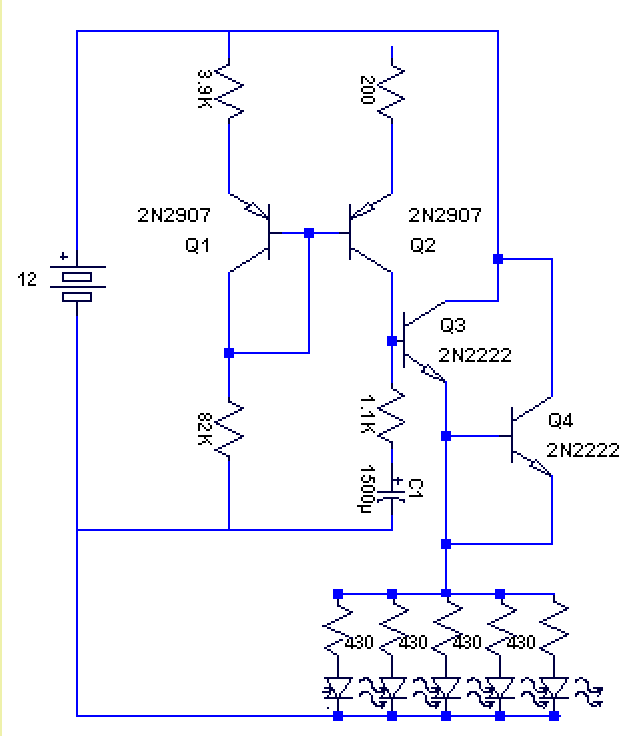


The same applies here. The upper circuit can be simplified to:

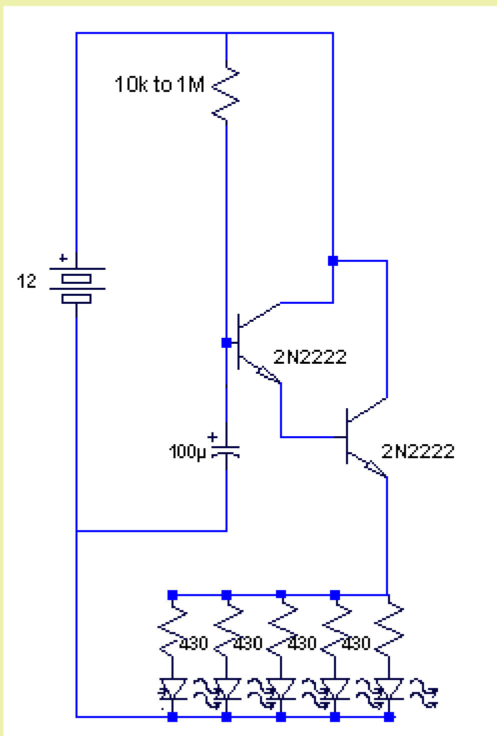


Circuit 2 takes **less current** and flashes the LED with a **much brighter illumination**. You can use 220u for an even brighter flash.

Here's another example of over-design. The following circuit was designed on a simulation package and although it does work, it has about 5 components that are not needed.
On top of this the circuit contains a number of faults. The first two transistors are an attempt to produce a constant-current circuit to charge the electrolytic. When the base of Q1 is connected to the collector, the transistor turns into a diode and the circuit limits the current that charges the electro. This may work but it uses 6 components that can be replaced with one component.
Connecting the base to the emitter of Q4 turns the transistor OFF and it is effectively removed from the circuit, so that Q3 is the only transistor providing and emitter-follower function to deliver current to the LEDs. This is a major fault in the design.

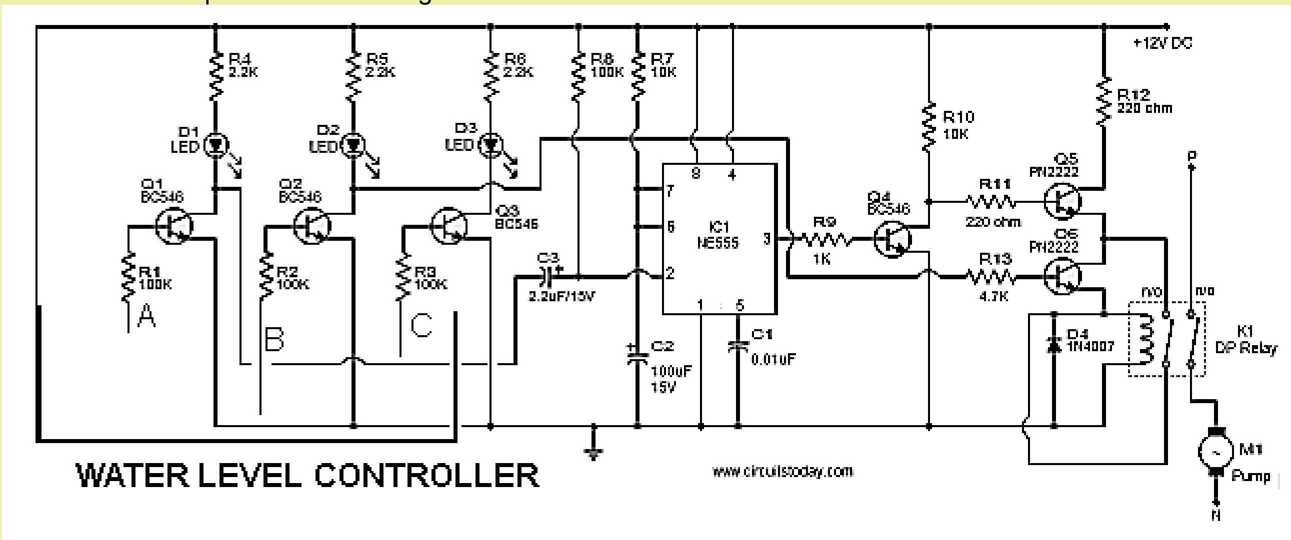


The following circuit is a copy of the one above with all the unused components removed and Q4 correctly wired:

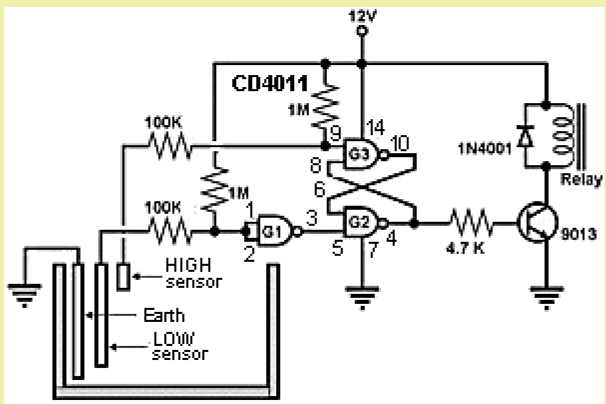


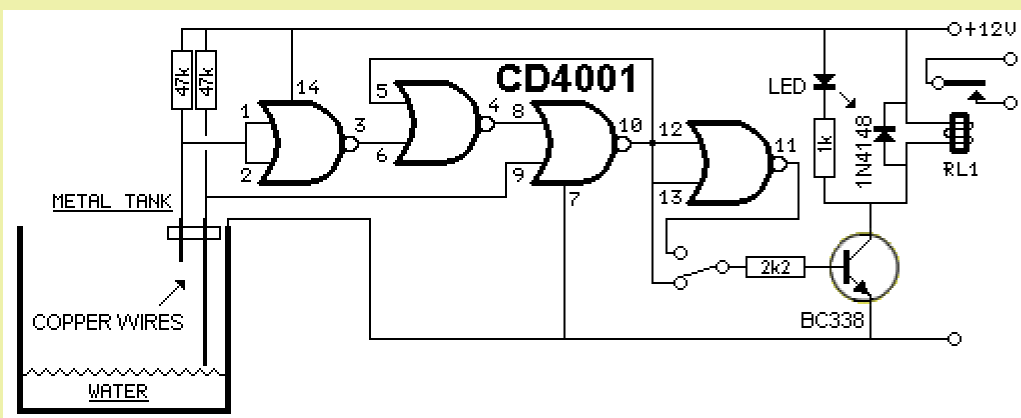
A simulation package does not make corrections to your design and you must go through each component and ask: "Is this item necessary?"

Yet another example of an over-designed circuit:



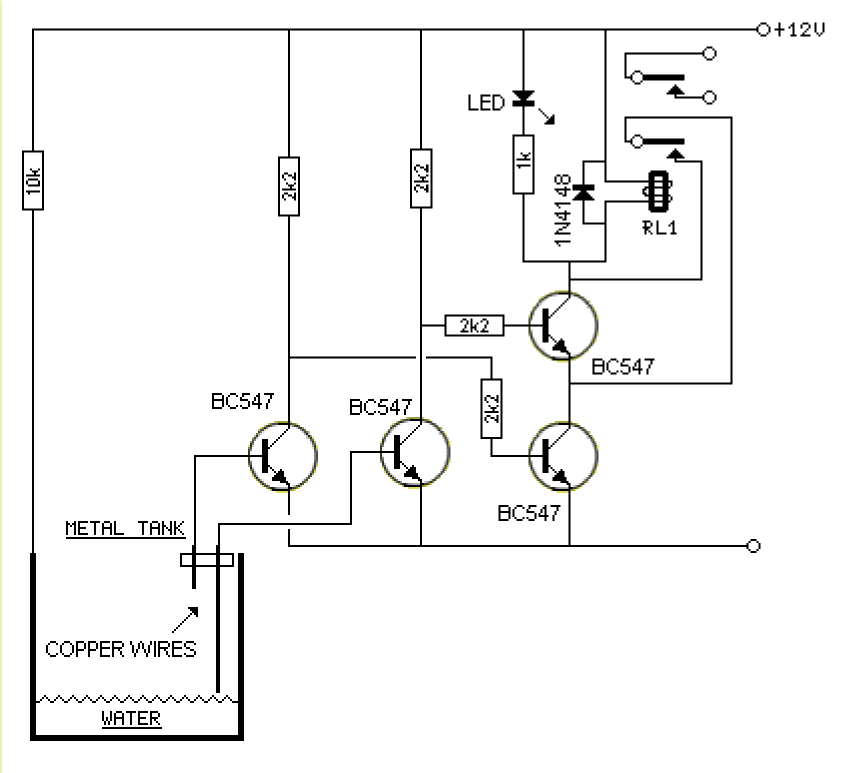
The circuit above can be simplified to one of the following:





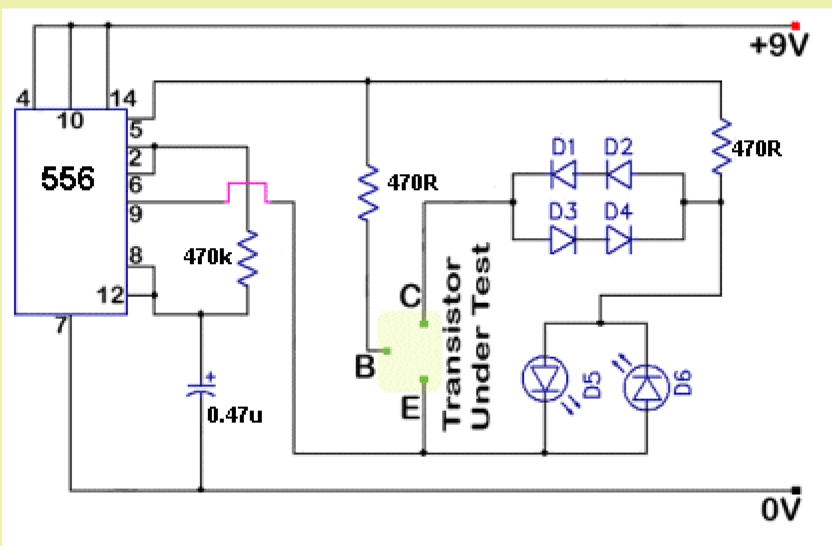
The original circuit has a major draw-back. The 555 takes 10mA and this is wasted current. The other two designs take much less than 1mA.

If you want a transistor circuit, here's a suitable design:

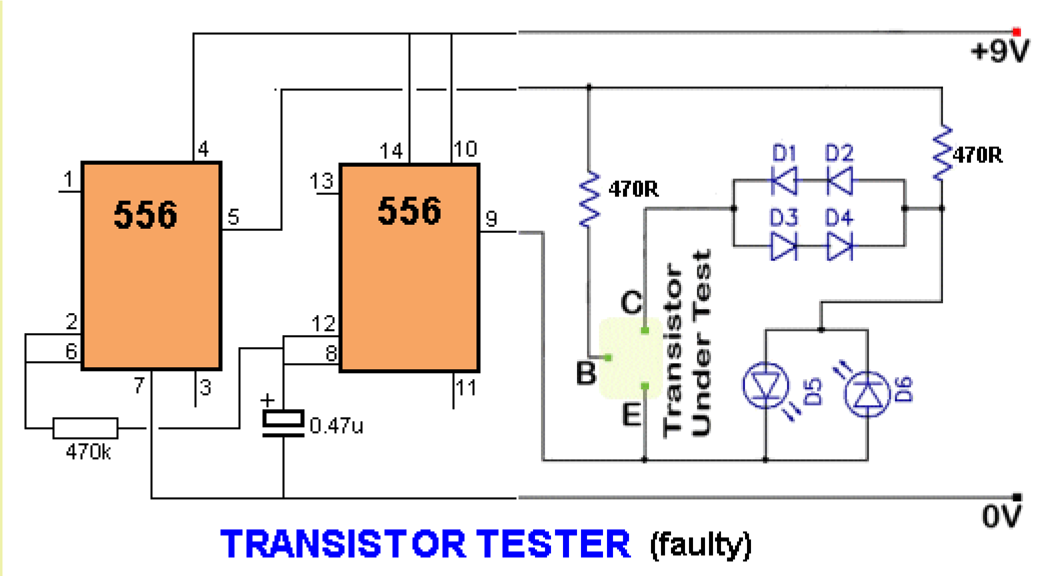


Before designing a circuit, do some research. Look on the web for equivalent circuits and see how your ideas compare with other designs. You will be amazed how much you can learn.

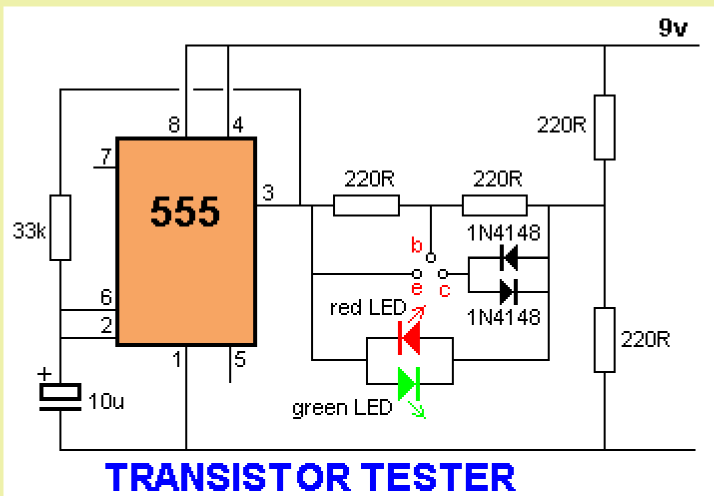
Here's a circuit that does not work. But you are not aware that some components are missing because the IC is a "double-555:"



When the circuit is redrawn, you can see the electrolytic is not being charged via the supply or discharged by the chip.
The circuit will not oscillate.

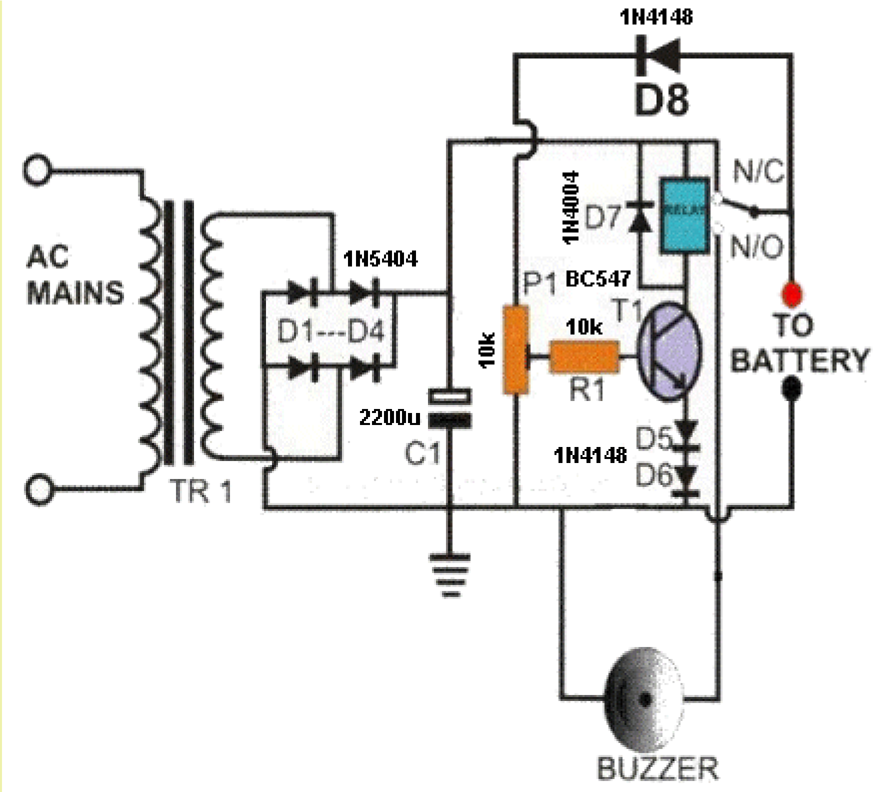


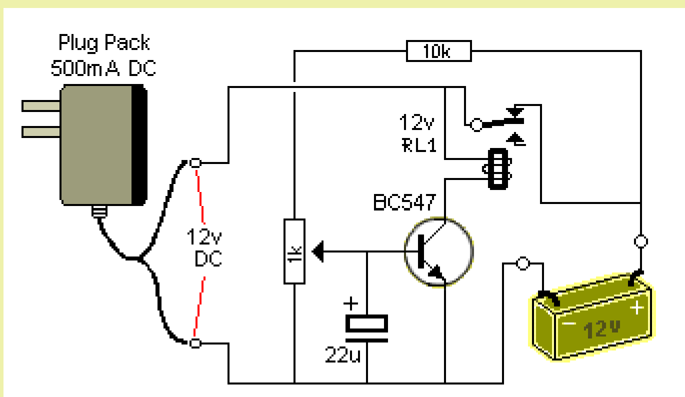
Here is a simpler circuit that works:



AUTOMATIC BATTERY CHARGER

Here's a very simple circuit with a lot of mistakes. It's a very simple automatic battery charger and the concept is very good, but the circuit needs some improvement. The author thinks the diodes in the emitter will increase the Hysteresis. But this is not so. As the voltage increases on the base of the transistor, the relay pulls in when the current though the base is high enough to activate the relay.
The two diodes simply put an extra 1.2v on the emitter, so the voltage on the base must be about 1.8v before the transistor will begin to activate the relay.
All the two diodes do is shift the activation-point 1.2v up the 10k pot.
D8 serves no purpose at all.
The 2200u electrolytic can be as low as 220u as very little current is being drawn by the circuit when the battery is not connected.
The 10k should be replaced with a 1k pot to make it easier to adjust the 13.7v trigger-point to detect when the battery is charged.
The 10k base resistor can be removed and placed in the position of D8. This means the 1k pot will have about 1v across it and this is 10 times better than the voltage across the 10k pot. The 13.7v adjustment will be much easier to achieve.
D7 is not needed as any spikes from the relay can be absorbed by the transistor. It will zener at about 45v to 55v.
All the corrections to this circuit can be seen in the second diagram.





AUTOMATIC BATTERY CHARGER

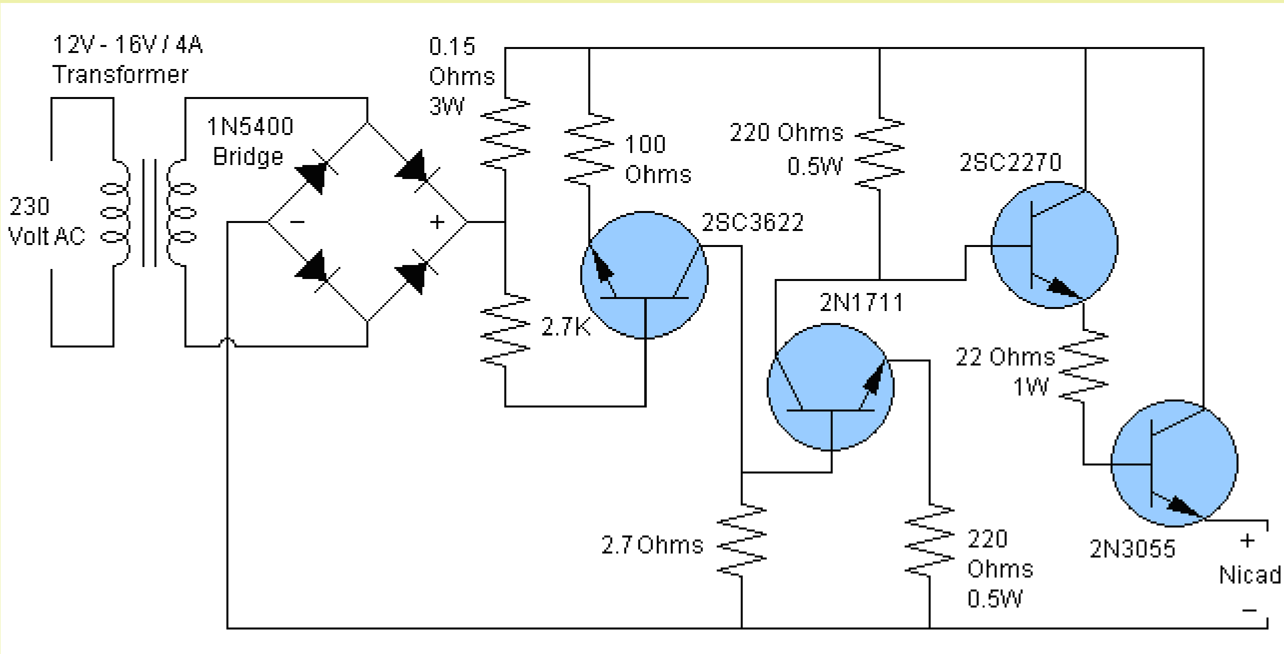
The plug pack can be 300mA, 500mA or 1A and its current rating will depend on the size of the 12v battery you are charging.
For a 1.2AH gel cell, the charging current should be 100mA. However, this charger is designed to keep the battery topped-up and it will deliver current in such short bursts, that the charging current is not important.
This applies if you are keeping the battery connected while it is being used. In this case the charger will add to the output and deliver some current to the load while charging the battery. If you are charging a flat cell, the current should not be more than 100mA.
For a 7AH battery, the current can be 500mA. And for a larger battery, the current can be 1Amp.

SETTING UP

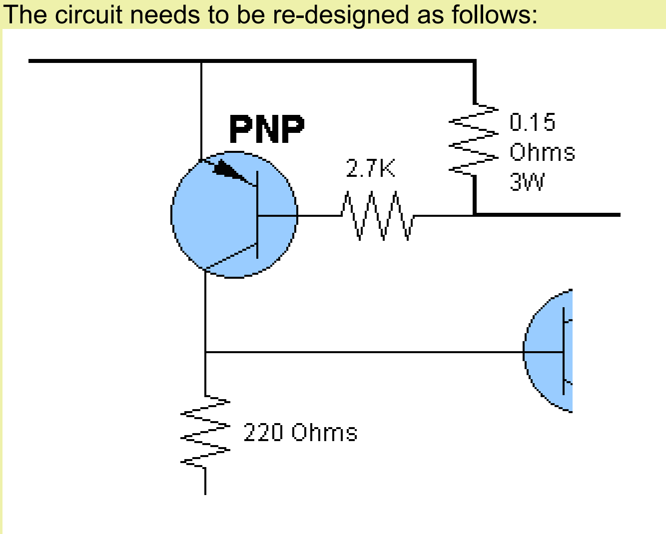
Connect the charger to a battery and place a digital meter across the battery. Adjust the 1k pot so the relay drops out as soon as the voltage rises to 13.7v.
Place a 100R 2watt resistor across the battery and watch the voltage drop.
The charger should turn on when the voltage drops to about 12.5v. This voltage is not important.
The 22u stops the relay "squealing" or "hunting" when a load is connected to the battery and the charger is charging. As the battery voltage rises, the charging current reduces and just before the relay drops out, it squeals as the voltage rises and falls due to the action of the relay. The 22u prevents this "chattering".
To increase the Hysteresis: In other words, decrease the voltage where the circuit cuts-in, add a 270R across the coil of the relay. This will increase the current required by the transistor to activate the relay and thus increase the gap between the two activation points. The pull-in point on the pot will be higher and you will have re-adjust the pot, but the drop-out point will be the same and thus the gap will be wider. In our circuit, the cut-in voltage was 11.5v with

270R across the relay.
Note: No diode is needed across the relay because the transistor is never fully turned off and no back EMF (spike) is produced by the relay.

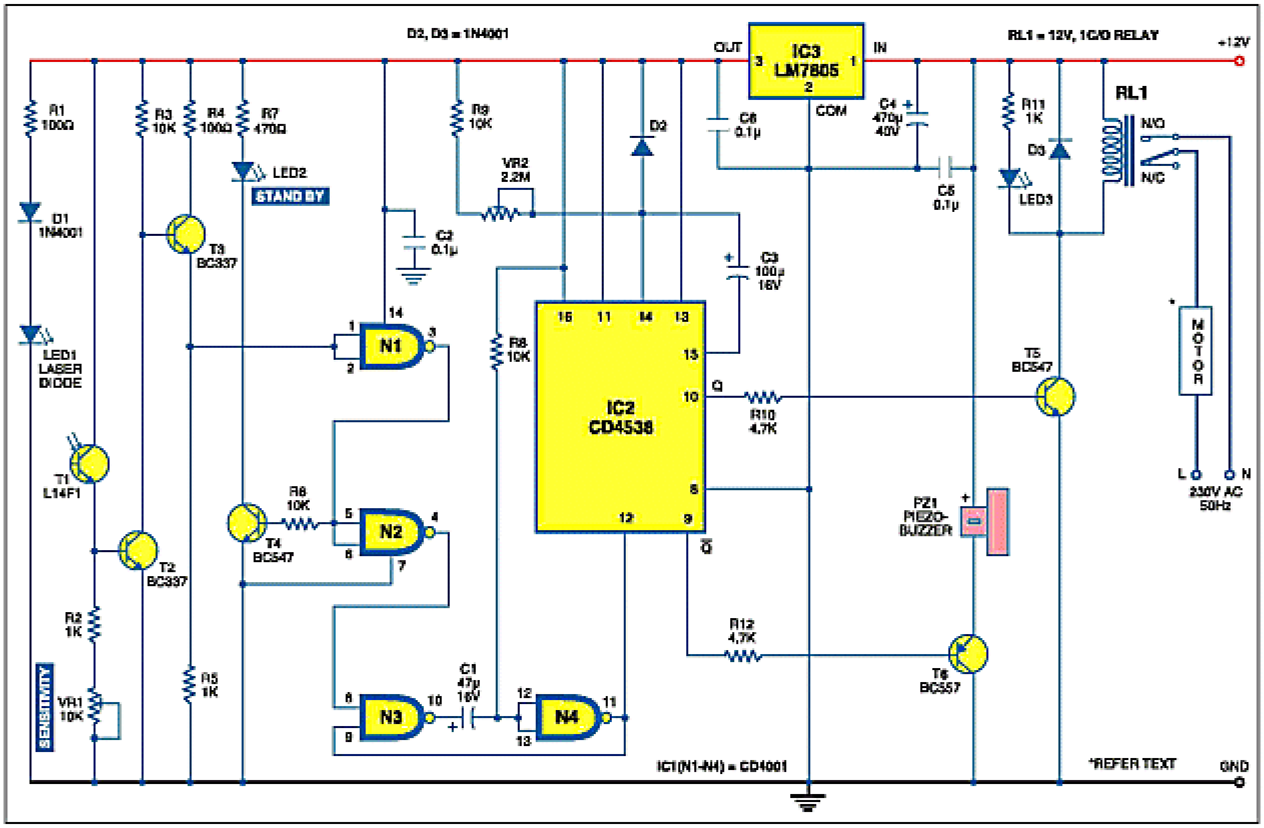
This looks like a fantastic battery charger circuit until you realise the first transistor is connected with the emitter to the positive rail and it will zener as soon as the 12v is applied and it will have a very low voltage across the emitter-collector AT ALL TIMES!



It's a pity the author of the site:
http://www.circuitdiagram.org/images/nicd-battery-charger-circuit.GIF
does not check his circuits before adding them to the web.
The circuit needs to be re-designed as follows:



Here's another circuit from Electronics For You - the Indian electronics magazine.
This circuit is filled with mistakes.

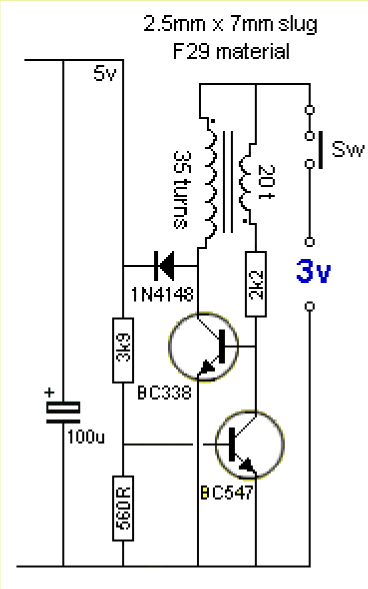


The NAND gate symbol on the circuit is a CD4011. A CD4001 is a NOR gate. Three of the gates are inverters, so either chip can be used. But gate N3 needs to be looked at.

CD4011 - NAND			CD4001 - NOR		
INPUT A	INPUT B	OUTPUT	INPUT A	INPUT B	OUTPUT
0	0	1	0	0	1
0	1	1	0	1	0
1	0	1	1	0	0
1	1	0	1	1	0

When light is falling on the receiver, pins 12 and 13 will be HIGH. Pin11 will be LOW, making pin 9 LOW. Pins 1 and 2 will be LOW, making pin 3 HIGH. This will put a LOW on pin 8. Thus the inputs to the gate we are considering is: LOW - LOW If we use a CD4011 NAND gate, you can see the output does not change if only one input changes, and thus we need to use a NOR gate.
The main problem is Qbar. It rises to 5v when HIGH but this allows the BC557 transistor to have a base-emitter voltage of about 7v and this will not turn off the piezo buzzer. To fix this, simply connect a BC547 transistor to the piezo buzzer with 4k7 to the Q output, just like the relay-drive transistor.
The last five faults are minor.
What is the purpose of diode D1? - it serves no purpose.
T2 and T3 need not be power transistors.
The 47u on pin 10 is around the wrong way.
T3, R4 and R5 are not needed. Theses three components form a voltage-follower and are not needed.
The 7805 regulator is not needed. The IC's will work on 12v. The only component that needs to be increased in resistance is the dropper resistor to the laser diode. The final value will depend on the current required by the type of laser diode you use.

I designed the following circuit to deliver 5v to a microcontroller project. It is capable of delivering up to 50mA with 75mV ripple at about 80Hz. It was provided as a suggestion to a reader on an electronics forum:



Another reader, with considerable experience in project-design, made the following comments:

It's not a great circuit to get high current out of. You need a good transistor that saturates to give a low voltage Vce when it is on, the BC337 is a good choice especially if it is a BC337-400 (beta 400).

But at high frequencies the BC337 might not have enough time to turn on hard, so there will be limit to L2 current and that means output current will suffer. Also it needs a couple of caps on the input, the big batteries won't supply the high freq current pulses very well, try a 100uF electro in parallel with a 10uF tantalum on the input.

It's probably not switching fast enough too, you can add a small cap between the collector of Q1 and the top of R3, to add a heap of positive feedback. It might also benefit from a small cap across R3 to give you about 0.2v ripple there to ensure a lower frequency and good turnoff of Q2.

Replacing the 1N4148 diode with a small Schottky 1N5819 that has lower forward voltage and higher current, that will help.

It's hard to get good current and good efficiency from a 2 transistor design, you may have to go to 2 transistors as the oscillator to ensure a good tight square wave operation, and use a third transistor as the voltage regulator in feedback.

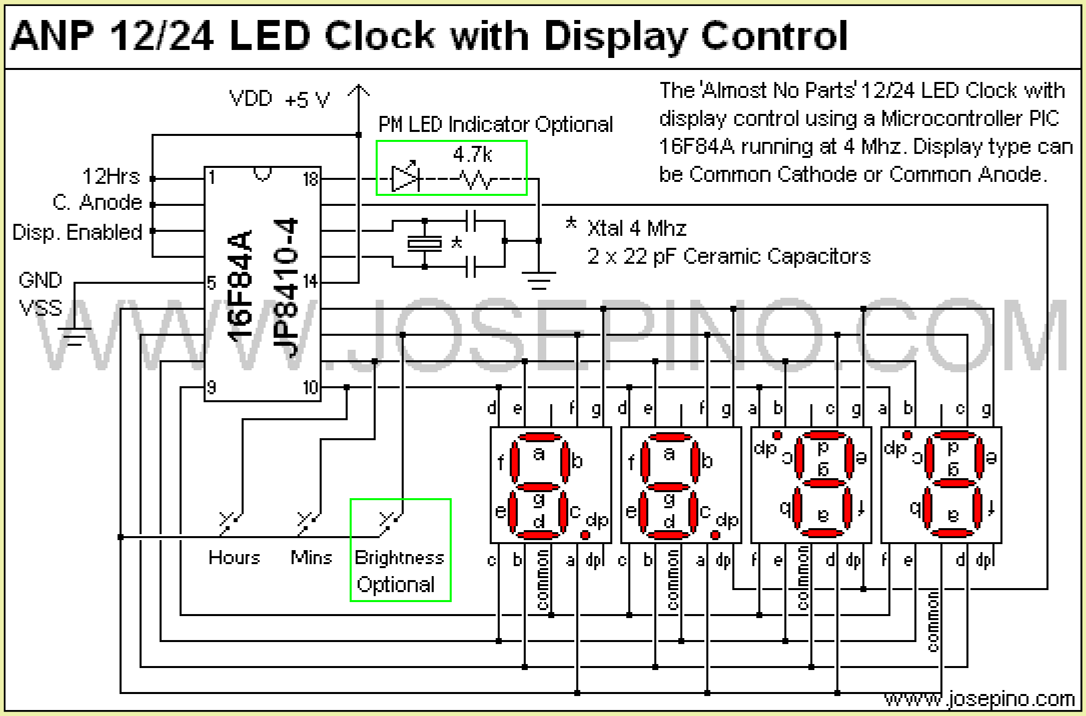
Most of the things that have been mentioned are basically untrue.

The circuit was never intended to provide HIGH CURRENT. It delivers 50mA at 5v with 30mV drop and 75mV P-P noise at 80kHz.
The 2k2 reduces the impact of the gain of the transistor enormously, so an extra-high-gain transistor is not going to be of any advantage.
The circuit has been especially designed “very lightly” so that it consumes very little current when the output is almost zero current. At present, it consumes 5mA.
An extra 10u tantalum electro on the input is not going to improve matters. A 100u is perfectly sufficient across the battery. However in the original design, the circuit delivers 50mA @5v and an electro is not needed.
Changing the diode is not going to alter the output as a 1N4148 will handle up to 70mA.
And saying you cannot get good efficiency from a single transistor is simply not correct. A single transistor works much better because it responds to the requirement of the transformer much better than delivering a long-duration square wave, that maybe over-saturating the core.
The circuit self-regulates as the input voltage drops, and turns on more to deliver the required output.
Before making comments on an open forum, readers should build the circuit and try the things they are suggesting.
If I didn't correct these suggestions, many readers would get a completely-wrong picture of the workings of the circuit.

No LOAD Resistors

You may find a microcontroller circuit on the web that does not use LOAD RESISTORS on any of the outputs, such

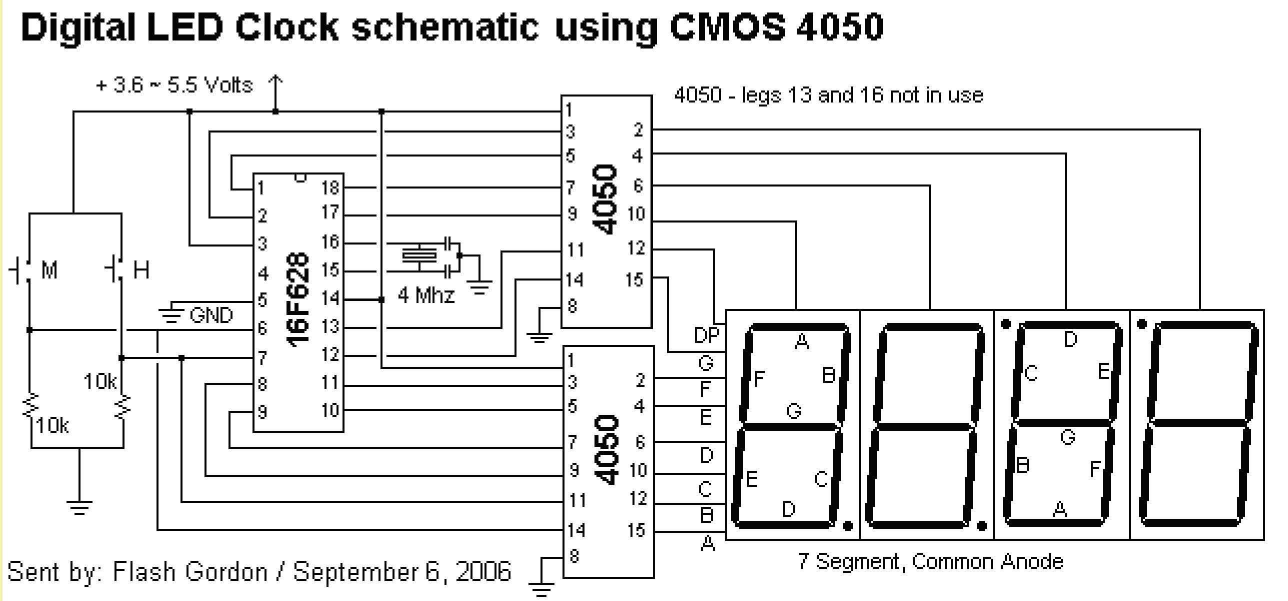
as this circuit by J Pino:
The circuit has a major fault.
There are no dropper resistors to any of the LEDs in the displays.



The problem with NOT USING resistors is this:
The output is not going fully HIGH. It is only going to between 1.7v and 2.3v, depending on the colour of the LEDs in the displays. This means the FET inside the micro is dropping 2.7v to 3.3v @ 25mA and this is a much higher wattage than the manufacturer of the chip has allowed-for. The chip has been designed for 25mA from each output but the output must be allowed to rise to nearly 5v.
With the design above, the chip can be dissipating between 460mW and 660mW.
The PIC16F84A has now been replaced by the cheaper PIC16F628A.

J Pino has updated his site with this absurd comment:
There are no resistors on most of my projects because I limit the current using the software instead of using resistors.
He is confusing OVERALL WATTAGE REDUCTION with CURRENT LIMITING.
Software does not reduce the current. It simply reduces the time when the current is delivered and this results in a reduction in wattage over a period of time.
But the instantaneous currents delivered by the chip when current-limiting resistors are omitted, can be more than the chip is designed to deliver.
For instance, a PIC chip connected directly to a LED will deliver about 33mA and the voltage across the FET driver will be about 3v (because the FET is not allowed to "pull-HIGH"). This gives a dissipation of 100mW. The FET will normally dissipate 25mA and the voltage across it will be 500mV, giving a result of 12.5mW. This is a BIG DIFFERENCE.

Here is another mistake from JosePino website:
"You can connect the CD4050's to 12v . . . . ."

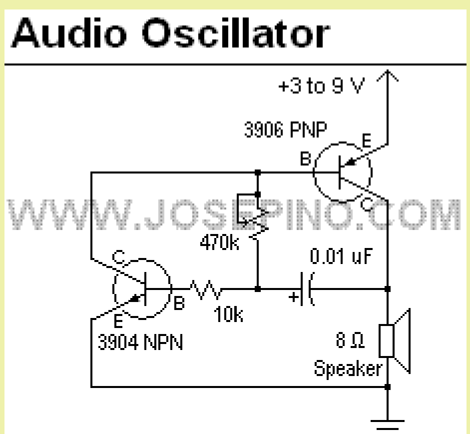


NO YOU CAN'T !!

If you connect the 4050's to 12v, the input of the chip will require a voltage higher than 6v for it to detect a HIGH and the output of the 16F628 is a maximum of 4.8v.
This is a point MISSED by J Pino because he did not test the circuit before adding this comment to his website.
Never say anything without testing the answer, no-matter how trivial.

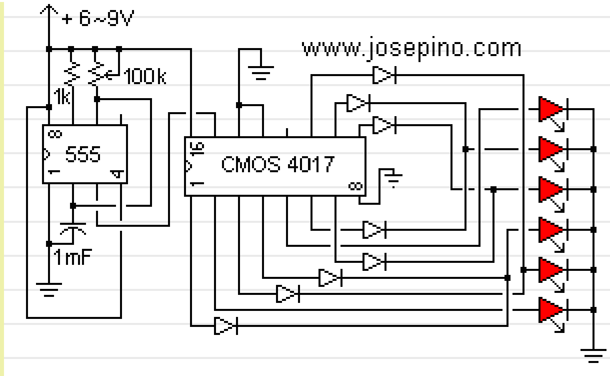
No Resistor

Here's another circuit from J Pino, where he has left out a safety-resistor. When the NPN transistor turns on, it turns on the PNP transistor and the voltage-drop across the collector-emitter junction of the NPN transistor is very low and the voltage drop across the base-emitter junction of the PNP transistor is 0.6v.
This causes a very high current to flow and is wasted-current.
A 10n capacitor does not have a "positive."



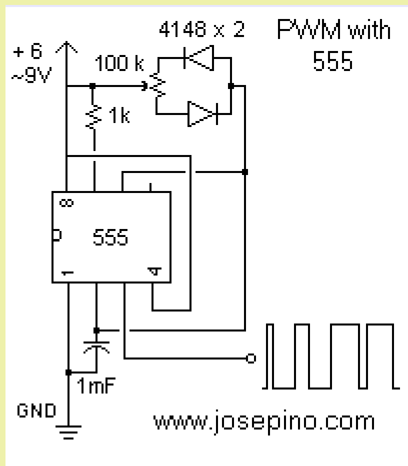
No Resistor - plus a resistor NOT NEEDED!

Here's another circuit from J Pino, where he has left out a safety-resistor. J Pino's website is very frustrating. Not only are there many mistakes in his circuits, but he does not make it easy to copy the circuits. It's totally ignorant people like this that we don't need on the web.
What is the point of producing a circuit if it cannot be copied and reproduced?
J Pino prides himself in leaving out important current-limiting resistors. He has done it again in this circuit. The row of LEDs should have a 330R current liming resistor so the output of the 4017 can go HIGH and deliver about 10mA to the LED that is illuminated at the particular instant.
However the most noticeable point about his ignorance in designing a circuit is the 1k resistor on pin 7 of the 555. This is not needed. The circuit will not work with pin 6 going to the positive rail. And 1mF is 1,000uF. This is a very large value for this type of circuit.



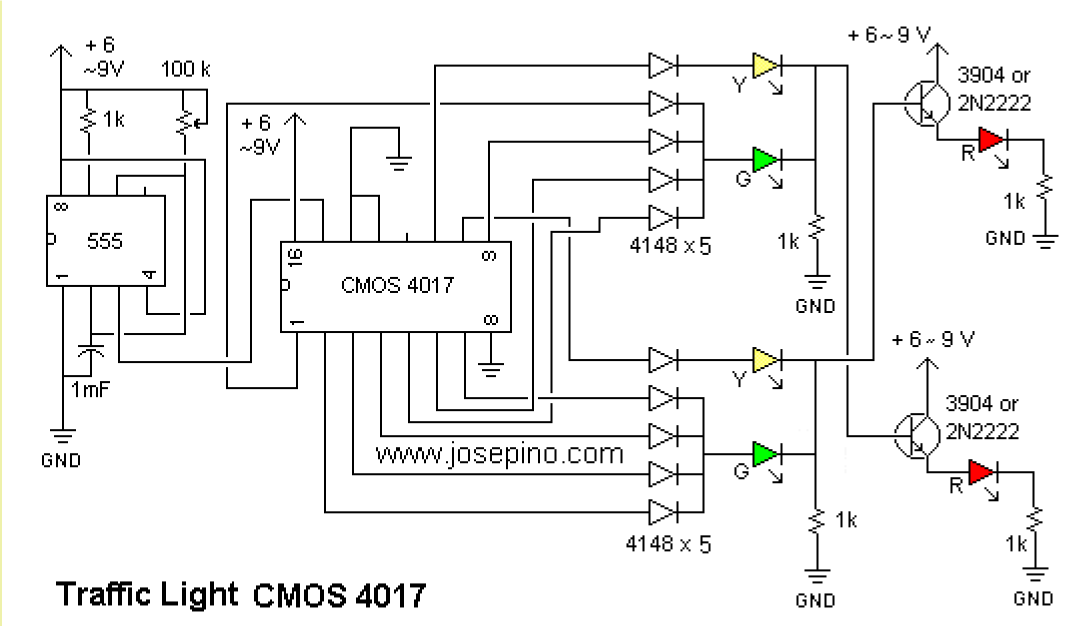
No Output

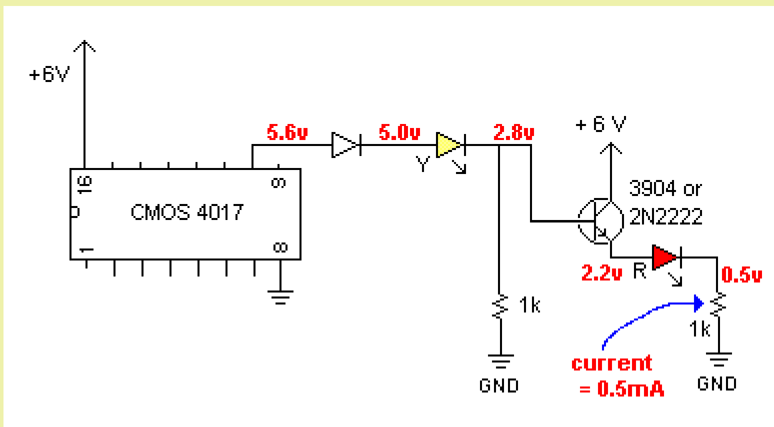
Here's another one from J Pino. He has not checked the circuit. It will not work. See 50 - 555 Circuits for the correct way to create a PWM circuit. It has been on his website for 5 years and no-one has made the circuit because you cannot copy the images!
Only a moron would create a website that cannot be copied! What is the point in providing information that needs to be copied to be reproduced, and not allow the circuit to be copied?



No Output

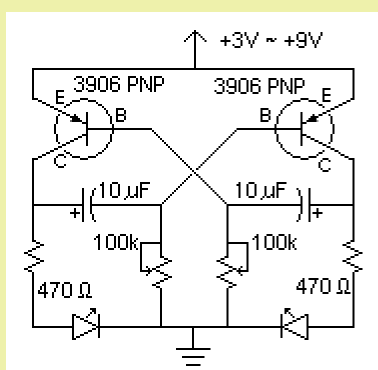
While on the topic of J Pino's website. Here's another one. Apart from the fact that the 555 circuit will not work, the emitter-follower transistor is not needed.
See The Transistor Amplifier on how to design transistor circuits.
The lower diagram shows the voltage-drops from the output of the 4017 and you will see how much voltage remains from a 6v supply, to drive the red LED. This circuit has obviously NEVER been tested and should not be presented on the web for others to get frustrated over.



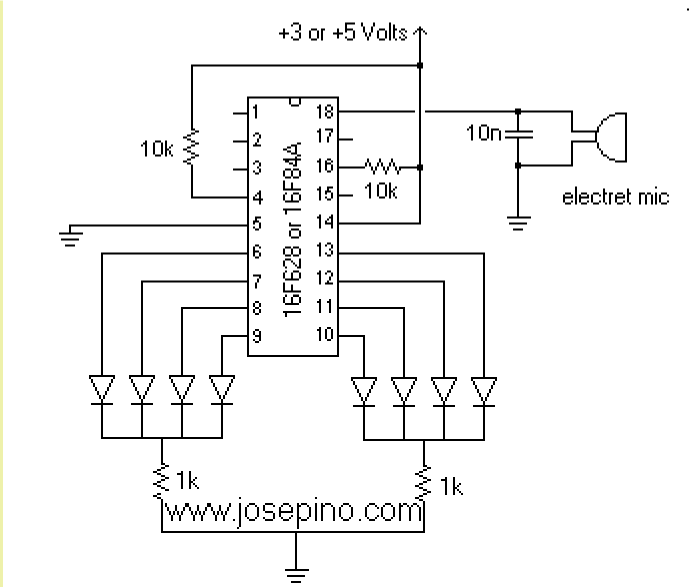


The diagram above shows the voltage-drops from the output of the IC to the red LED. It does not matter if the collector of the emitter-follower is connected to the 6v rail, the emitter cannot be higher than the input voltage and this circuit provides 0.5v across a 1k resistor to deliver 0.5mA to the red LED.

Another J Pino's mistake. The electrolytics are around the wring way. The base is always just below rail voltage the end of the electrolytic connecting to the base should be the positive of the electrolytic.

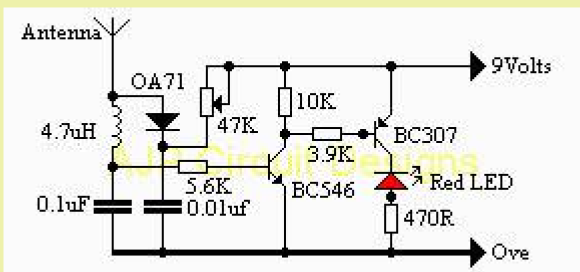


Another J Pino's mistake. The electret mic is connected directly to an output pin. The pin is taken HIGH then the pin is made and input and the time taken to discharge the 10n is recorded. There is no resistor in series with the 10n to provide a "time delay" and an electret mic should never be connected directly to a 3v or 5v supply.
There is no "electronics understanding" behind this feature.



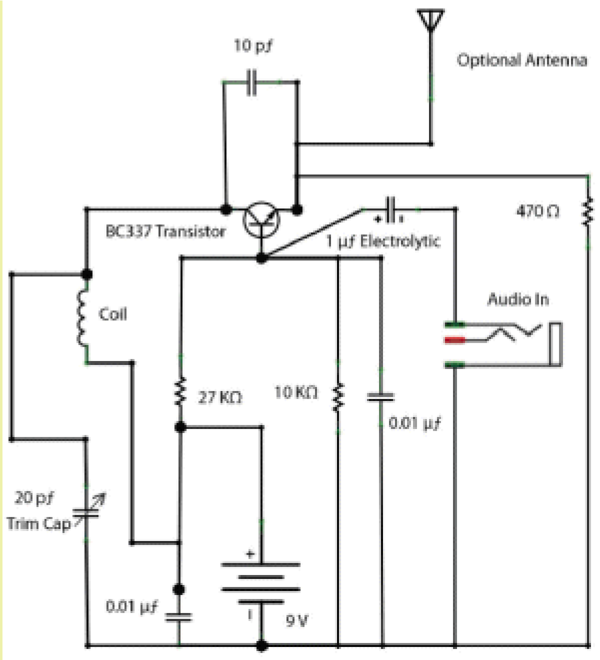
LED!!!

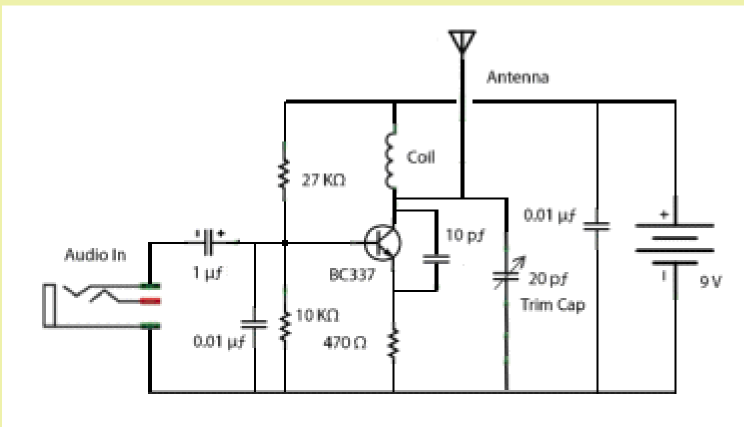
Here's another fault. The LED is up-side-down!!



MICRO BUG

I have mentioned, so many times, the importance of drawing a circuit with all the components in the correct locations, so others can instantly recognise how the circuit operates.
Here is a circuit, that is a total mess:



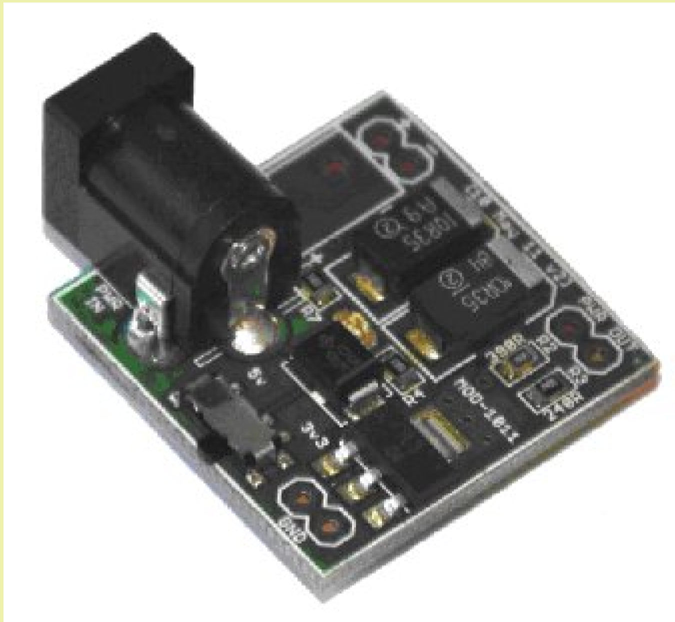


By re-arranging the components we see the circuit is a normal FM transmitter but the 20p trim cap is connected to the negative rail. This will work just as effectively as connected to the positive rail however the position of the component does not make it obvious the 20p and coil are in an arrangement called a TANK CIRCUIT and this is the most important part of the circuit as these two components have a natural capability to oscillate and produce a sine-wave, when a small amount of energy is delivered to them. Not only do they oscillate, but they produce a waveform that can be considerably higher than the delivered-voltage.
This is one of the most amazing things in electronics and when it was discovered, (over a hundred years ago), it changed electronics completely. It was the birth of RADIO. The only other complaint is the type of transistor. A BC337 is a power transistor and not really suited to high frequency.

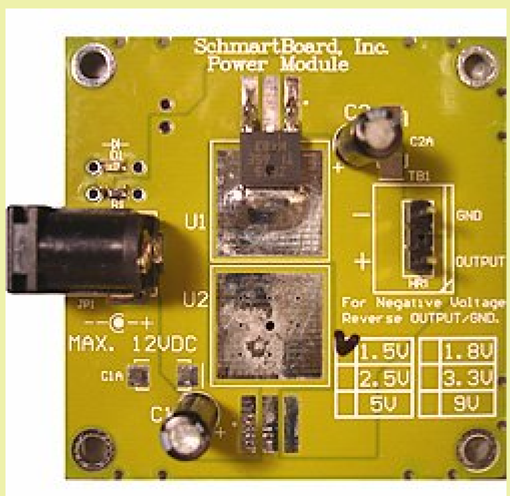
1-AMP POWER SUPPLY MODULE

Here is a major mistake from two different suppliers. Both modules use a 3-terminal regulator to reduce the input voltage to 5v and/or 3.3v and they specify the current capability of the module is 1AMP! . Neither module has any heatsinking on the regulator and neither designer has any idea of the heat produced when a current of 1 amp flows.
Here is a lesson to be learned: When a diode is passing 500mA, it gets very hot. When it is passing 700mA, you cannot hold your fingers on it. When it passes 1 amp, you can boil water on the leads.
This is the sort of temperatures we are talking about when approx 0.65v is dropped across the diode at 500mA. The voltage drop increases to 0.75v at 700mA and increases to 0.95v at 1A.
That's why the temperature rises so much. The diode is dissipating nearly 1 watt when 1 amp flows.
To prevent the diode being damaged, the leads must be short and connected to lands on a circuit board to take away the heat.
Now we come to the 3-terminal regulator.
It needs at least 1.5v across it to provide regulation. This means the minimum wattage being dissipated will be 1.5watts.

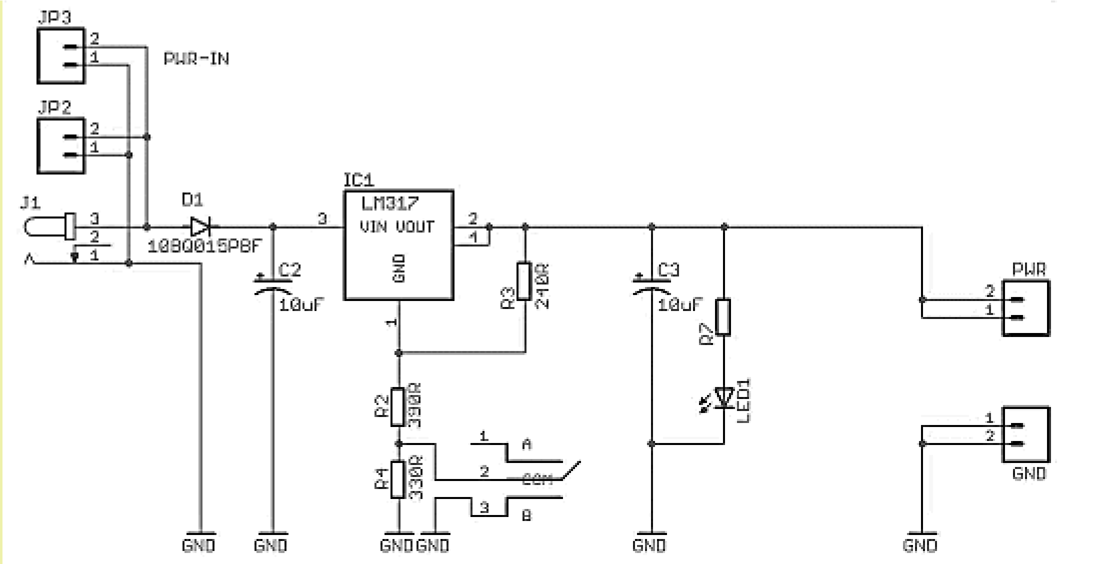
Neither board has any form of effective heatsink and the component will definitely BOIL WATER.
In most cases the input voltage will be 3v to 15v higher than the output voltage and you can imagine the heat being generated. The only way to prevent the regulator DE-SOLDERING ITSELF, is to reduce the current.
Neither of these power supplies will be able to deliver more than a few hundred milliamps (or less). They are extremely badly designed. They should provide the ability to heatsink the regulator - as it will need heatsinking in most cases.



Power Supply from Embedded Adventures.com

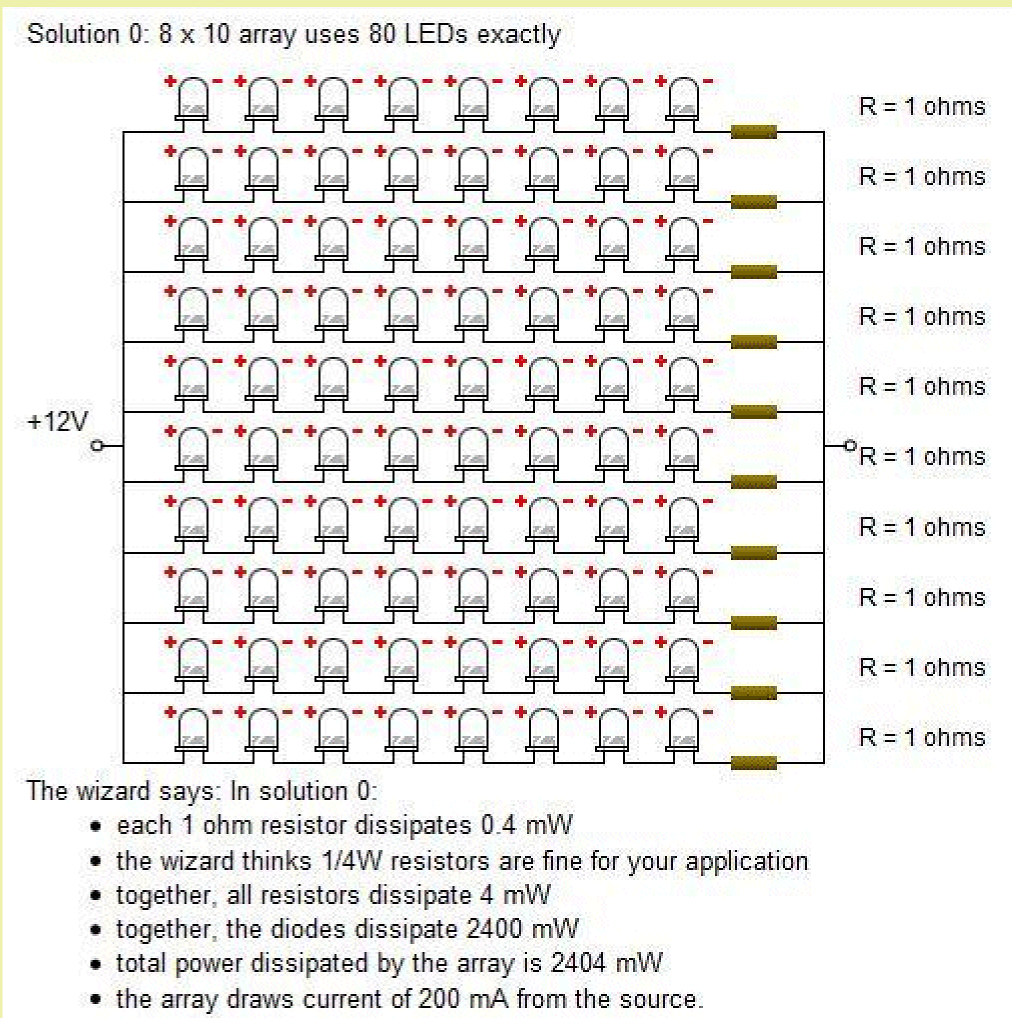


Power Supply from SchmartBoard. Inc



THE DANGERS OF USING A "LED WIZARD"

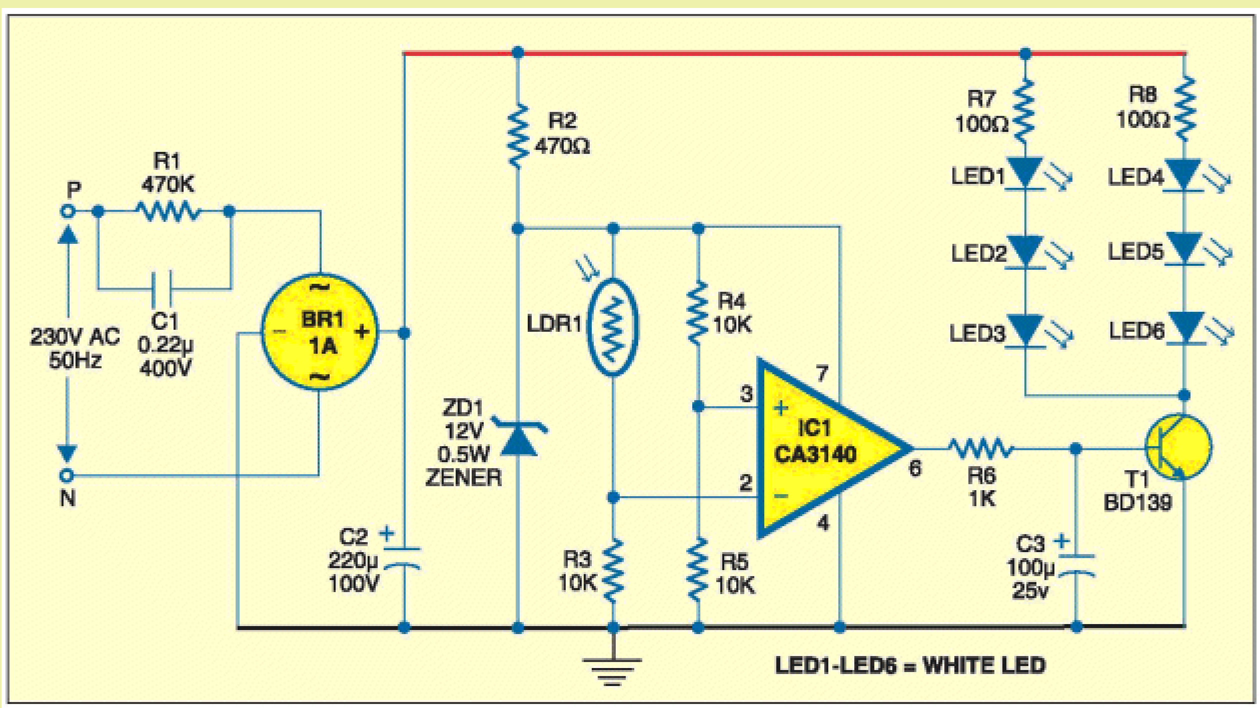
You can find a LED WIZARD on the web that gives you a circuit to combine LEDs in series and/or parallel for all types of arrays.
Here is an example, provided by a reader. Can you see the major fault?



The characteristic voltage (the colour of the LED) is not important in this discussion. Obviously white LEDs will not work as they require 3.4v to 3.6v to operate.
The main fault is the dropper resistor.

Read our article on LEDs.
The most important component is the DROPPER RESISTOR.
It must allow for the difference between the maximum and minimum supply voltage and ALSO the maximum and minimum CHARACTERISTIC VOLTAGE of the string of LEDs.
When we say a red LED has a CHARACTERISTIC VOLTAGE of 1.7v, we need to measure the exact maximum and minimum value for the LEDs we are installing.
Some high-bright and super-high-bright LEDs have a Characteristic Voltage of 1.6v to 1.8v and this will make a big difference when you have 8 LEDs in series.
Secondly, the 12v supply may rise to 13.6v when the battery is being charged and fall to 10.8v at the end of its life.
Thirdly, you need to know the current required by the LEDs.
The normal value is 17mA for long life.
This can rise to 20mA but must not go higher than 25mA
You should also look at the minimum current. Many high-bright LEDs will perform perfectly on 5-10mA and become TOO BRIGHT on 20mA.
As you can see, it is much more complex than a WIZARD can handle.
That's why it produced the absurd result above.
The maximum characteristic voltage for 8 red LEDs is 8x1.8v = 14.4v
This means you can only put 6 LEDs in series. = 10.8v
The LEDs will totally die when the battery reaches 10.8v
The value of the dropper resistor for 6 LEDs and a supply of 12v @20mA = 60 ohms. When the battery voltage rises to 13.6v during charging, the current will be: 46mA. This is too high.
The CURRENT LIMITING resistor is too low.
We need to have a higher-value CURRENT LIMITING resistor and fewer LEDs.
Use 5 LEDs:
The characteristic voltage for 5 LEDs will be: 5 x 1.7v = 8.5v
Allow a current of 20mA when the supply is 12.6v   Dropper resistor = 200 ohms.
Current at 10.8v will be 11mA. And current at 13.6v will be 25mA
Now you can see why the value of the CURRENT LIMITING RESISTOR has to be so high.

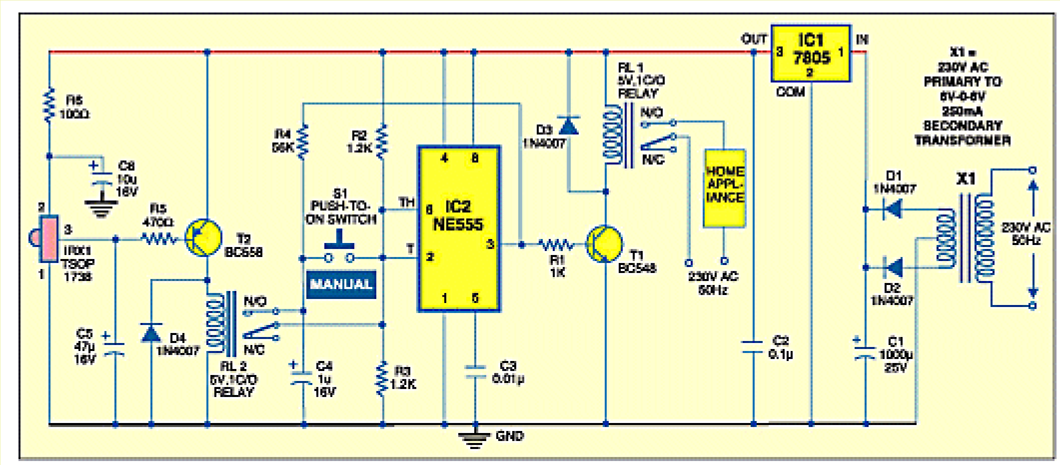
More EFY mistakes:



The circuit is far too complex. The .22u allows about 15mA to enter the circuit. This gives 7mA for each string of white LEDs, Hardly enough to bother about. The LED should have been in series.
But the biggest mistake is adding an earth to the project. This will create a SHORT CIRCUIT if the "P" and "N" wires of the mains are reversed by accident.
The BD139 can be replaced by an ordinary low-current transistor and the IC can be omitted and the LDR connected directly to the transistor.
In all, this circuit is a disaster in design and shows how NOT to design a circuit..

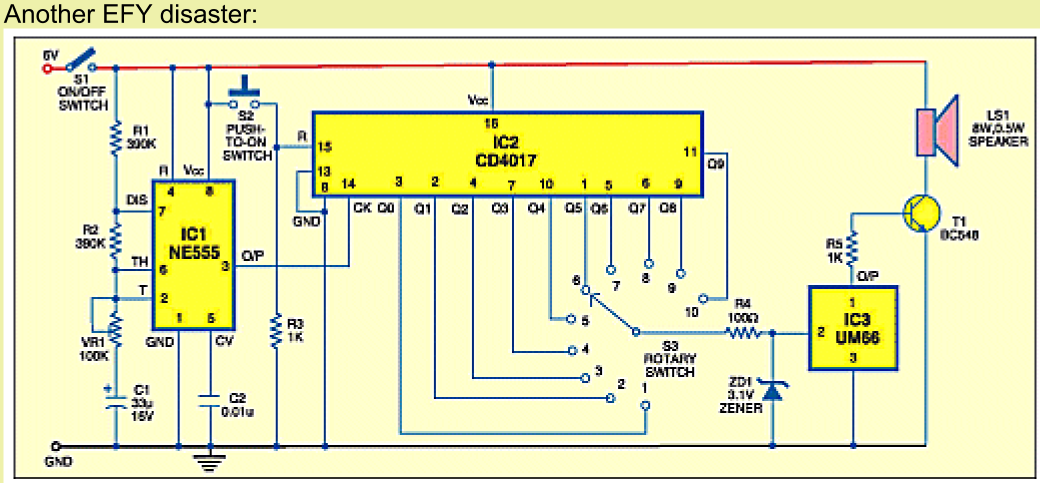
The Author D Mohan Kumar has proven to be a disaster in designing circuits and should not be given the space in an electronics magazine.

More EFY mistakes:



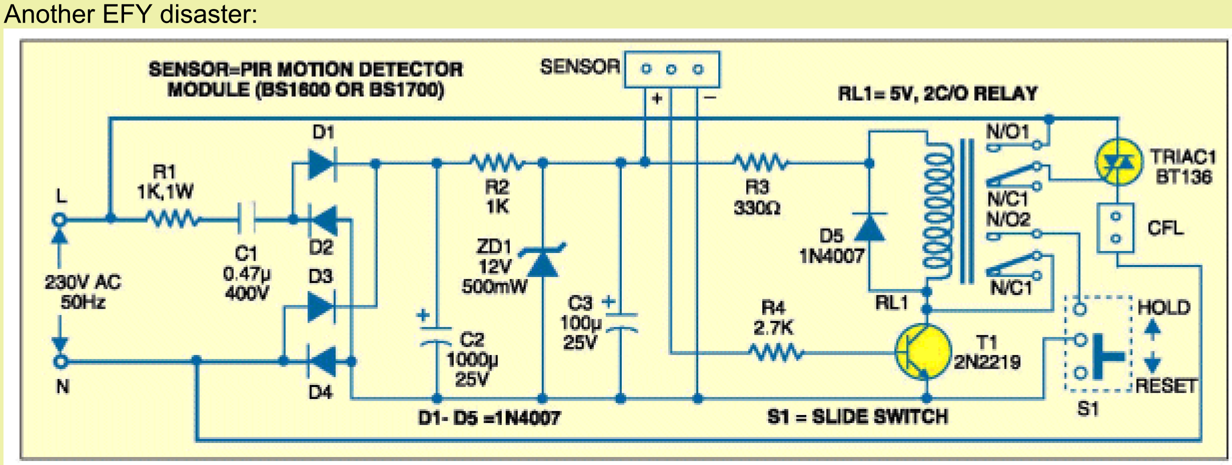
The 555 is placed in toggle mode and the author of the circuit has had to use a relay to activate the chip.
This is one of the worst designs ever. The wrong chip has been used and the relay is a poor inclusion.
The chip should be a flip-flop in toggle mode and the relay is not needed. This is another poor **Indian** design and shows the lack of understanding of electronics. The magazine **Electronics For You** needs harsh criticism.

Another EFY disaster:



The circuit turns on the music chip after 30 seconds, or 60 seconds, etc to 4min 30 seconds.
I cannot think who would want this feature but the circuit is over-designed and takes more than 10mA when sitting around doing nothing. It then plays the same tune after every 4.5 minutes and the rotary switch has no purpose. The circuit is badly designed and is a typical Indian disaster.
It just needs a two-transistor delay (timer) and a pot - connected to the chip.

Another EFY disaster:



The 0.47u capacitor on the input will deliver a maximum of 35mA. The current required by the relay is not known but suppose it is a 50mA device. This means it has a resistance of 100R. The 330R resistor on the 12v supply, when combined with a 100R relay will pass just 28mA. The relay will not work.
Suppose the relay is a 30mA type, the 330R combined with a 170R relay will pass 24mA. The relay may work, but it is very special type.
The whole circuit is badly designed and the resistance of the relay is very important. The circuit has never been tested and omitting the resistance (impedance) of the relay is a major mistake.
Every circuit in **Electronics For You** magazine has a mistake and should be avoided.

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SPOT THE MISTAKES!

Page 12

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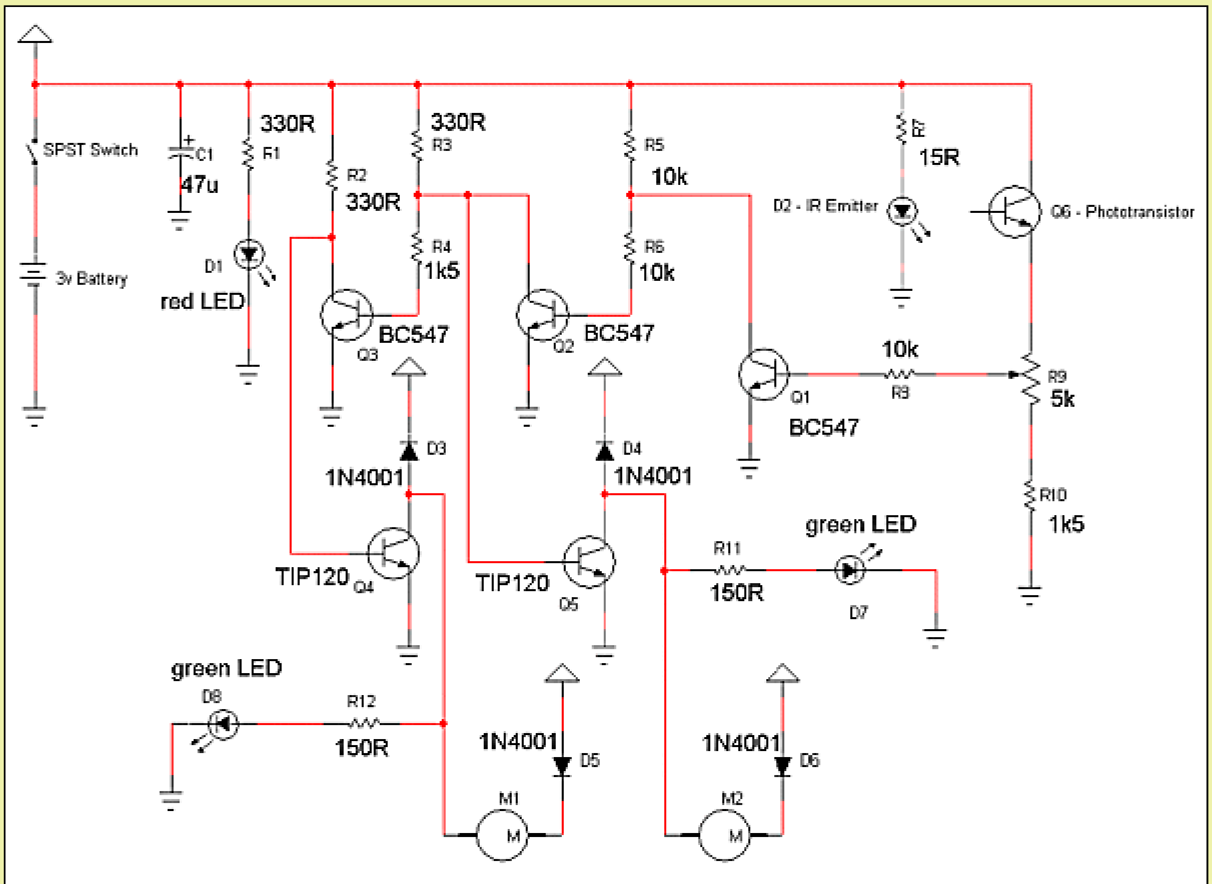
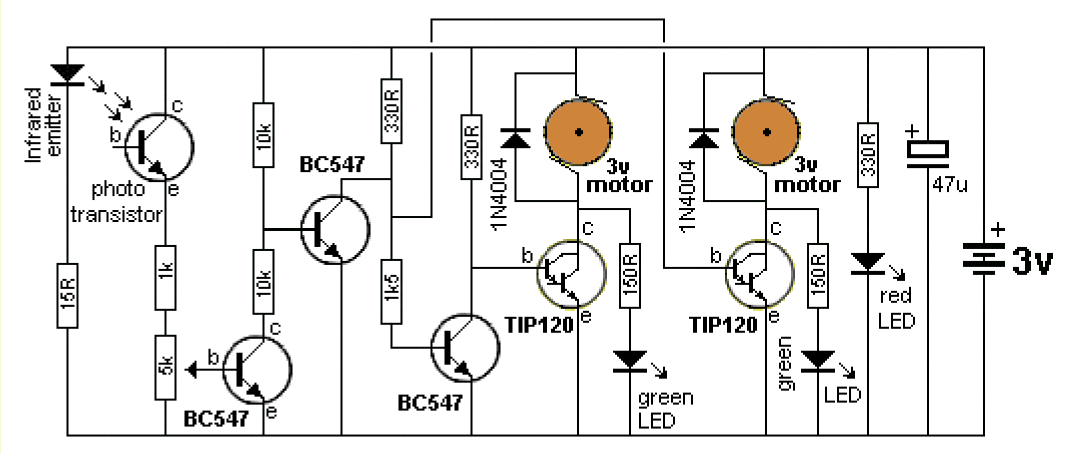
We start another page of faults, hints and corrections to circuits found on the internet.
I am surprised at the number of faults and poor designs produced by authors who boast a university degree and experience in prestige places such as NASA's Jet Propulsion Laboratory, as stated by our first designer: Chris @ PyroElectro.com
His circuit for a **White Line Following Tank** has a number of points worth mentioning. Here is his circuit:

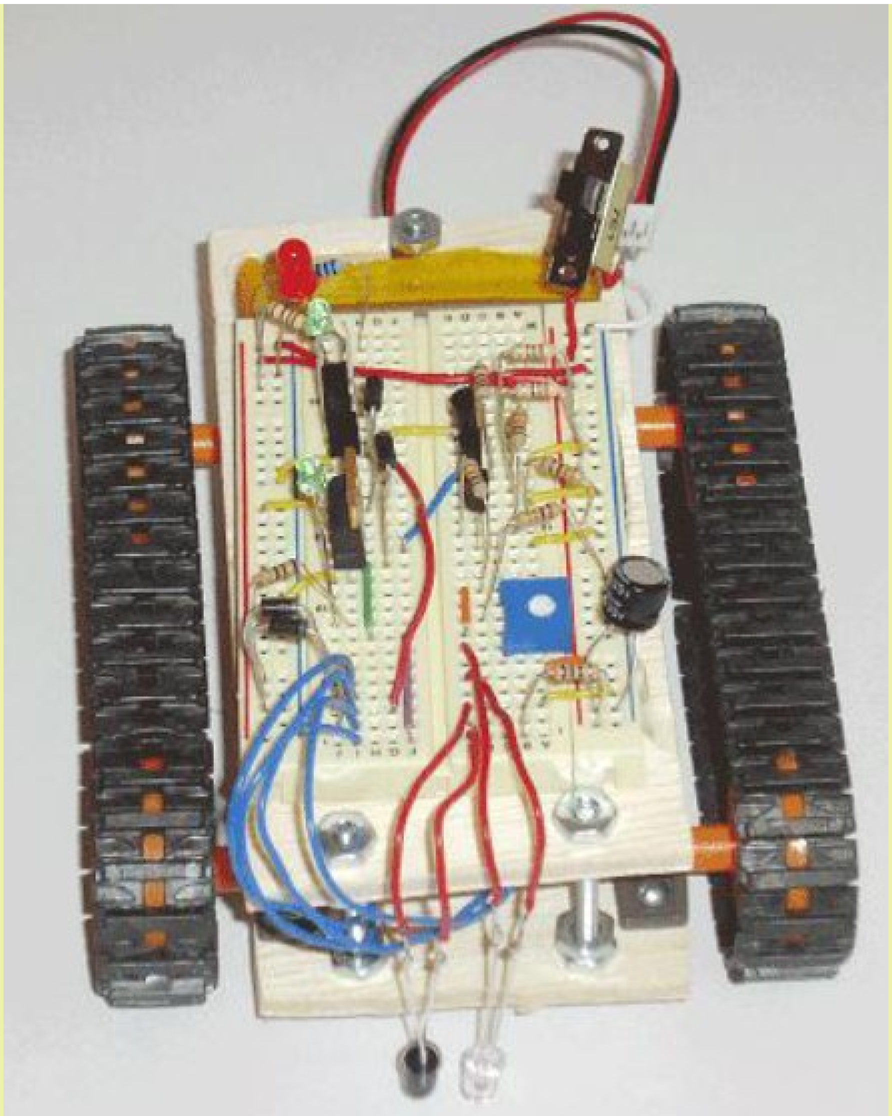


Mini-Tank Line Follower Circuit Diagram

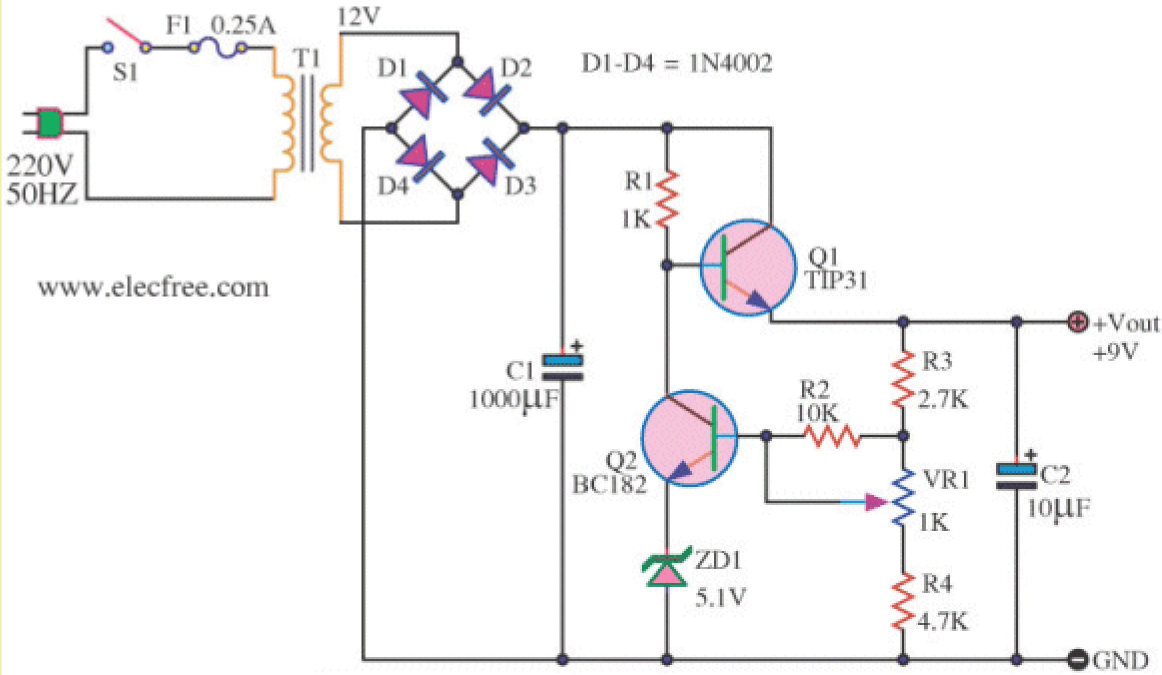
The layout is a "dogs breakfast."
The first thing that "threw me" was the diode on the TIP120 transistor. I could not see what is was doing.
Then I had to work out that the TIP was a Darlington transistor.
There were other mistakes but the layout was so poor I had to redraw the circuit to make it easy to understand. The result is shown below:



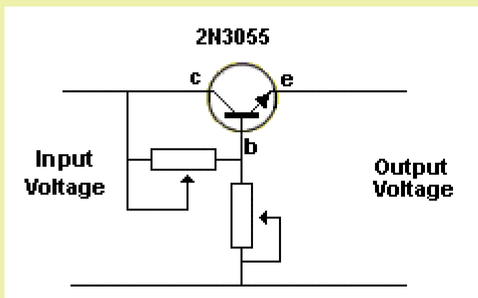
The circuit is over-designed.
This is easy to see.
The TIP120 is pulled HIGH via a 330R resistor.
A photo-transistor receiving light has a resistance of about 300R. This means only a single amplifying stage is needed between the photo-transistor and the Darlington output transistor.
In addition, the base of the transistor driving the second motor could be taken from the collector of the first TIP120 transistor.
This would save 2 transistors.
Two diodes and a resistor have removed from the original circuit as they are not needed.
The circuit does work, as shown in the following photo and a full description of its construction can be found at: http://www.pyroelectro.com and an eBook on building Robots:
http://www.pyroelectro.com/book/Building-Robotics-&-Electronics.pdf
The only point I am making is the fact that the circuit had no component values (I added the values from the construction-notes), the layout was incomprehensible and is over-designed.
The author was informed of these details and has failed to update the circuit.
I realise many authors are extremely embarrassed when confronted with faults and most completely fail to respond.
That's why it is so dangerous to surf the net and conclude that everything you see is correct and functional.
Before accepting any circuit, collect at least 2 or 3 similar designs and see if they correspond with each other.



This circuit is a good design but the 10k resistor (R3) is not needed and the 5v1 zener diode serves no purpose. The output voltage is being determined by voltage across the collector-emitter terminals of Q2 (about 5v) and the zener voltage. Why not simply use the voltage divider consisting of R3 VR1 and R4 to create about 10v across the collector-emitter of Q2 and remove the zener. The circuit will operate exactly as the original design. With these changes we have eliminated two unnecessary components.

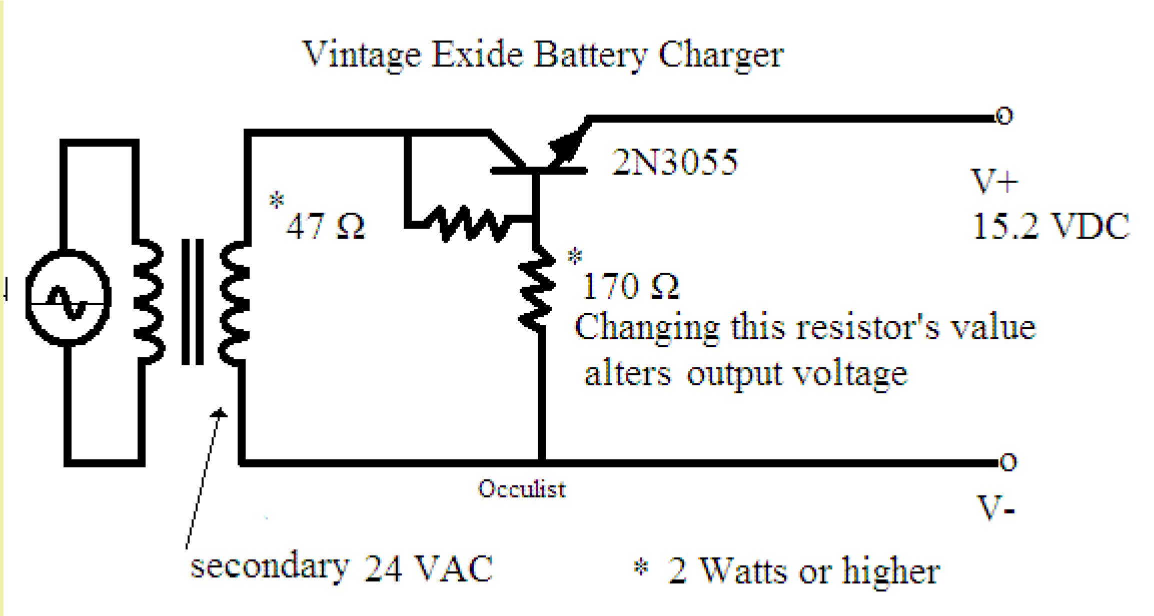


Here is a dangerous circuit from Alternative Energy Circuits Blog by occulist - J McPherson



If both pots are turned to low resistance, they will create a short-circuit and will be damaged. A damaged lower pot will cause the output voltage to rise and damage the circuit you are supplying.
The answer by J McPherson: *2 pots are fine in the circuit. If the 2 pots are set to near short condition - one will blow out like a fuse.*
What an absurd statement to make.
It's designers like J McPherson that should not be displaying their stupidity on the web.
If the lower pot fails, the output will rise and damage the circuit you are protecting!!!!!!!!

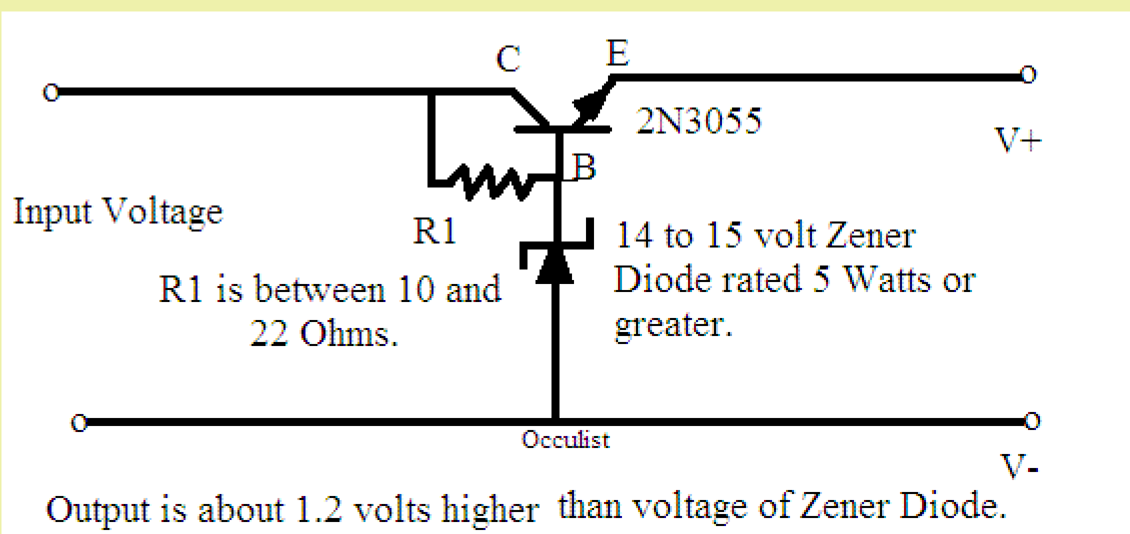
Here is a another circuit from Alternative Energy Circuits Blog by occulist - J McPherson



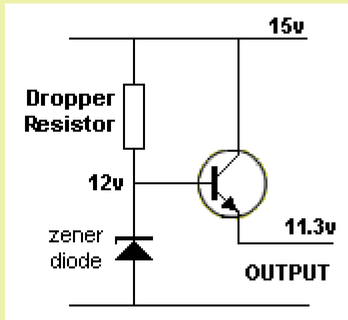
The output voltage will not be 15.2v
The peak voltage produced by 24v AC secondary will be 34v. The transistor will only pass the positive portion of the waveform to produce pulsed DC on the output. The 47R and 170R voltage dividers will deliver a peak of 34/217 x 170 = 26v
Any battery connected to the output will see pulses of 26v and the charging will never cease.
I don't see any purpose in this design and it is certainly not a "Regulated Battery Charger" as stipulated on the website.
The only thing that may reduce the charging current is the limitation of the transformer. It will possibly be a low wattage design.
The 47R needs only 0.5 watt.
It's absurd to use a high voltage secondary transformer then dissipate a lot of wattage in the external components.
The circuit is a very poor design and shows how NOT to design a battery charger.

J McPherson makes the statement: *"Lead acid batteries are very tolerant for their voltage inputs."* I don't know what he means but this statement but if you want a charger to turn off when the battery is fully charged, the detection-point is very critical. The actual voltage depends on the type of battery and must be within 100mV of the specified voltage, otherwise the battery will eventually DRY OUT. Some batteries have special compounds mixed with the paste in (on) the plates to increase the point at which gassing occurs. This is one of the features of a MAINTENANCE FREE battery.

Here is a another circuit from Alternative Energy Circuits Blog by occulist



The output is NOT 1.2v higher than the voltage of the zener diode.
occulist was notified of this and could not see the reason. He has not fixed the problem on his website.
That's why many websites are very dangerous. They contain faults that the unsuspecting reader will interpret as fact.
When the circuit is drawn as shown below, you can clearly see the output voltage is always 0.7v below the voltage of the zener. That's why it is important to draw a circuit so it makes the operation of the circuit easy to understand. For more details on The Transistor Regulator, see The Transistor Amplifier eBook.



NITPICKING

The only reaction I have had from J McPherson from Alternative Energy Circuits Blog is to say I am "nitpicking."
He claims everyone is clever enough to realise the circuits he has presented on his site contain faults and no-one will fall into the trap of putting two pots across the power rails and create a short-circuit, or build a battery charger without knowing the characteristics of the transformer.
In addition, he claims it is quite normal to use a 1M pot to create a resistance between 1k and 100R then measure the pot and substitute a resistor.
He obviously has absolutely no idea of the capabilities of the average reader on the web.
90% of readers are beginners and have no ability to correct a faulty design.
Neither J McPherson nor Jose Pinto have made corrections to their site. They are obviously so embarrassed that so may faults have been picked up that they have nestled into a corner and closed their eyes.
These "**Spot The Mistake**" pages are not "nitpicking" but highlighting the fact that many mistakes can be found on websites and in technical books.
After all, why do you think a book is read by a technical proof-reader before it is published?
I have been a proof-reader in the past and before many books go to press, they contain myriads of mistakes.
In some cases, every page needed corrections and these books were intended for junior school electronics classes. Imagine the problems if they went to press without corrections.
J McPherson fails to realise one important point. A circuit will not work unless it is 100% correct.
It is fortunate that these sites attract very few readers but if you go to forums such as: http://www.electro-tech-online.com/ you will see the result of readers trying to build a faulty circuit.
It's only through a network of dedicated electronics professions who willingly assist on these forums that the beginner can find a resolution to his problem.
Faulty websites, untested articles in magazines and poorly presented text-books are a danger to the newcomer.
They pick up wrong terminology and when the circuit does not work, they are likely to get frustrated and give up the hobby.
This especially applies to circuits in the magazine: **Electronics For You.** It nearly always contains poorly designed projects and this makes it doubly-difficult for a reader to get a circuit to function correctly.

That's why we will keep adding to these pages.

The best way to learn a subject is by observing the faults of others.

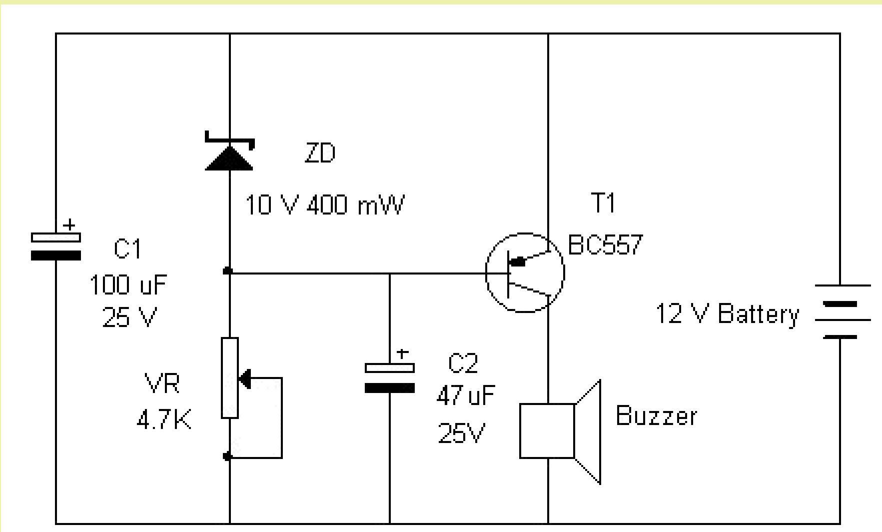
Here's another disastrous design by D.Mohan Kumar
The circuit has NOT been tested as it DOES NOT WORK.
He is supposed to be a University Lecturer in India. No wonder Indian students go overseas for a real education. Nearly all of his circuits have a mistake. He has never replied to any corrections and continues to deliver faulty circuit, not only on the web, but in **Electronics For You** magazine.
Go to our eBook The Transistor Amplifier for the operation of a PNP transistor. The voltage between emitter and base is never more than 0.7v. What is point of putting a 10v zener across this junction?

Here is his article. Can you see where he has made a major mistake?

A PNP transistor BC 557 functions as a voltage controlled switch. As you know, PNP transistors forward bias and conduct only when its base is grounded. A Zener diode is used to control the switching of T1. In the 12 volt battery monitor, 10 volt Zener is used. When the battery voltage is above 10 volts (The breakdown voltage of Zener), the Zener conducts and the Base of T1 becomes positive and it remains off. Buzzer will be also in the off state. Variable resistor VR adjusts the exact biasing of T1 at 10 volts and C2 buffers the base of T1 positive as long as Zener is conducting.

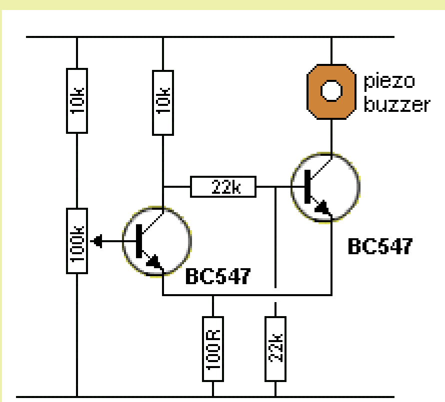
Here is his mistake: D. Mohan Kumar thinks the zener diode will break down at 10v and only a very small voltage will appear across it. This is not so. At 10v, the zener will break down and 10v will appear across it. However the zener is connected between the emitter and collector of the PNP transistors and the voltage between these two leads cannot be higher than 0.7v as this is the characteristic of a transistor. So, the zener never sees 10v.

Here is the way to analyse the circuit:
As the supply increases from 0v, the transistor is turned on via the 4k7, when the supply reaches about 0.8v. And as the supply increases, the current through the emitter-collector leads increases. The supply can increase to 10v, 11v, 12v, 15v and the zener never sees more than 0.7v across its terminals.



12v BATTERY MONITOR

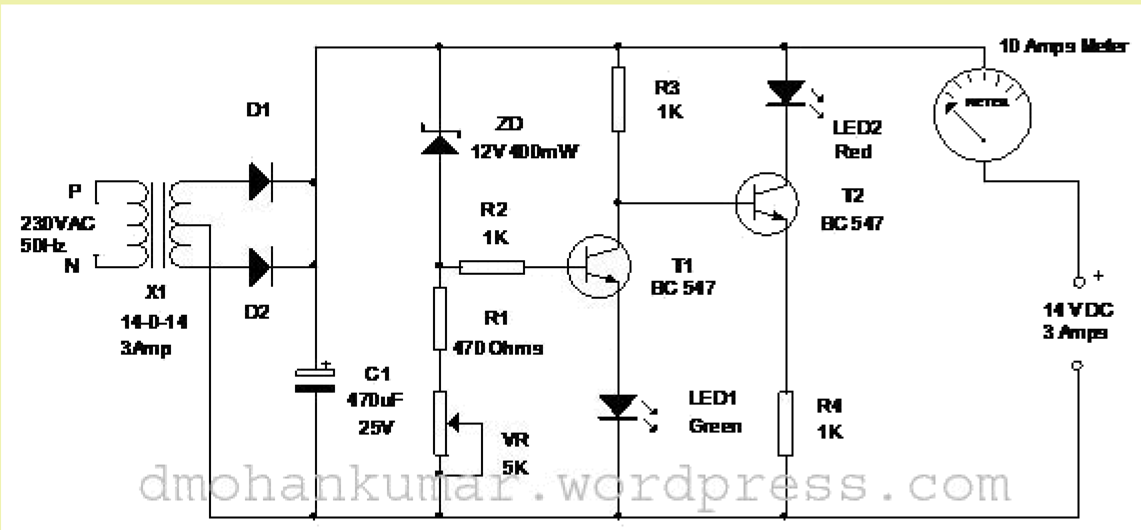
The following circuit will activate the piezo buzzer when a 12v supply drops to 10v:



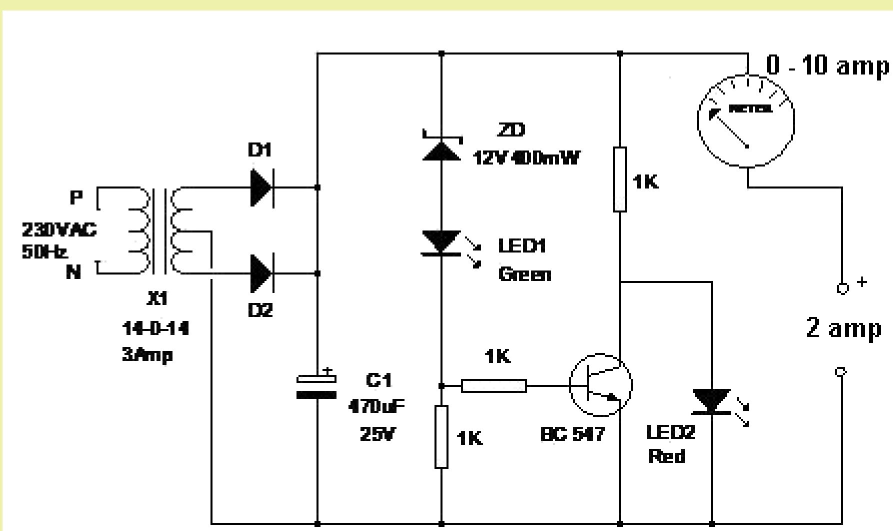
The two transistors operate as a Schmitt Trigger.

Here's another design by D.Mohan Kumar

The circuit does work but can be improved. You can learn a lot from other people's mistakes.
The first mistake is the rating of the supply. The 14 - 0 - 14 3-amp transformer is an AC rating.
This means the voltage is 14v AC and when it is rectified, the voltage becomes 14 x 1.4 = 20v.
The 3-amp rating of the transformer is also an AC rating and since we have gained extra voltage from the voltage component of the rating, we must derate the current so the wattage (the volt-amp) rating of the transformer remains the same.
This means the AC current rating becomes 3 x 0.7 = 2.1amp DC.
The second fault is the 5k pot. The "pick-off" from the 12v zener is taken directly from the zener and this means the 5k pot will have no effect on adjusting the voltage.
The third improvement is the removal of the second transistor and a few components. These are not required when the circuit is re-designed.
The 470u will have no effect on smoothing the supply when a battery is connected.
The supply is not regulated so you cannot say the output is 14v. It is 20v when unloaded.



The original 3-amp charger circuit



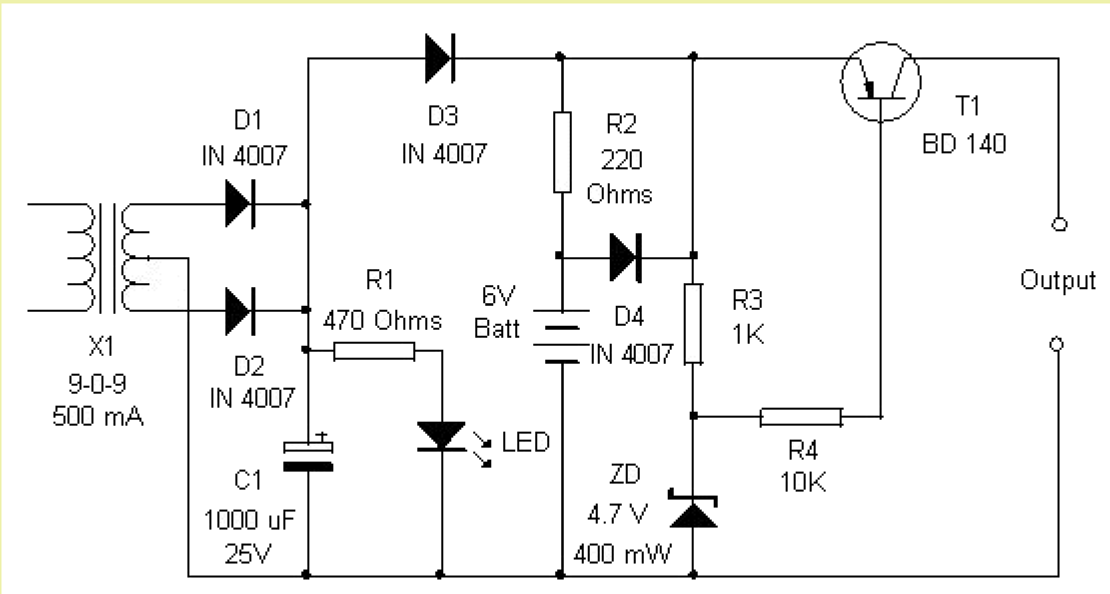
The improved circuit

Here's another faulty design by D.Mohan Kumar

Here is his original article. The corrections are in bold RED. The circuit is a terrible design but here is the best that can be done with circuit:

Transformer X1, diodes D1, D2 and capacitor C1 forms the charger section. X1 is the centre tapped 9-0-9 step-down transformer with 500 mA current. Diodes D1 and D2 are rectifiers to convert 9 volt AC to 9 volt DC. **It converts 9v AC to 12.6v DC**. High value capacitor C1 removes AC ripple from 9 volt DC to

get clean DC. **The 1,000u is not needed. The circuit is charging a battery and the battery accepts pulses.** LED indicates the power on status and resistor R1 limits LED current to 20 mA. Under normal condition, 9 Volt DC passes through D3 and R2 to the battery for charging. Resistor R2 limits the charging current to 40 mA (9 / 220 = 0.4 Amps x 1000 = 40 Milli Amps) for slow charging since the charging is process is continuous. The current will be (12.6 - 6v) divided by 220 = 30 mA. At the same time, the load gets power through the PNP medium power transistor BD 140 and functions normally. **NO! It does NOT! The transistor will deliver only a few milliamp. See The Transistor Amplifier eBook for details on how to design this section of the circuit.** 9 volt DC **It is 12.6v DC**. is used to charge 6 volt battery since 2-3 volts excess is necessary for normal charging and the circuits itself consumes some power. Output voltage will be around 6-8 volts. **It is 12.6v DC.**



6v BACK-UP SUPPLY WITH FAULTS

Diodes D3, D4 and the battery form the backup section. When the mains power is available, D3 forward bias to provide power to the battery and the load. When the mains power fails, D3 reverse biases and D4 forward biases so that current flows from the battery to the load. D3 prevents the back flow of battery current to the transformer. **Diodes D1 and D2 prevent reverse current to the transformer. D3 simply prevents the LED illuminating when the power fails**.

Resistors R3, R4, zener diode ZD and transistor T1 are the components of the cutoff section. When the battery voltage is more than 5.3 volts (4.7+0.7=5.4) zener conducts, taking the base voltage of T1 to ground. **No. The base of T1 sits at 4.7v** Since T1 is a PNP transistor, the negative base bias allows it to conduct so as to provide load current. **This is false**. When the battery voltage drops below 5.3 volts, zener stops conducting and the base of T1 becomes positive through R3, R4 and it switches off. **This is false**. This cuts off power to the load. This condition remains as such till the mains power regains. **This is ALL false**

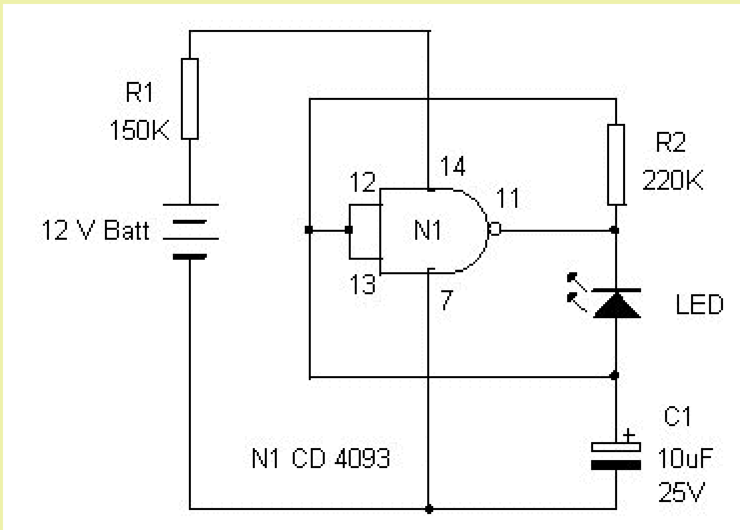
You can see how many mistakes the author has made.
He has the wrong concept of how a zener diode works and no idea how to design a transistor output stage.
When the main is alive, the output current will be determined by the current though R4.
The current though R4 is 12v. - 0.7 - 4.7 = 7.2 divided by 10,000 = 0.72mA If the gain of the transistor is 100, the current will be 72mA.
The authors circuit simply does not work at all when the main fails.
The emitter sits at 6.3v - 0.7v = 5.6v and the base sits at 4.7v. This give a turn-on voltage of 0.9v. The battery only has to drop 0.2v and the circuit stops working. The output current will be a maximum of a few milliamps.

You cannot provide all the features the author is requiring when using a 6v battery. The diode- drops and transistor voltage-drops leave almost no voltage for the devices you are powering.

Here's another faulty design by D.Mohan Kumar

Here is his original article. The corrections are in bold RED. The circuit is a terrible design as it uses a 12v lighter battery to flash a 3v LED. A lighter battery has very little energy (about 23mAhr - 30mAhr) and is expensive. The circuit will not last very very long.

Here is a **Dummy LED flasher** to confuse intruders. It **simulates** the **LED blinking** of a sophisticated alarm system. It can **flash for years** both day and night using a single 12 volt alkaline battery (lighter battery). **The battery will last just a few days!** If the life of the battery permits, it can flash continuously for more than **10 year**s. Theoretically it is true since the LED consumes less than 5 microamps. **This is untrue. The LED consumes about 20mA.** The interesting feature of the Flasher is that, the **LED lights** by taking current not from the battery, but from the capacitor. **True.**

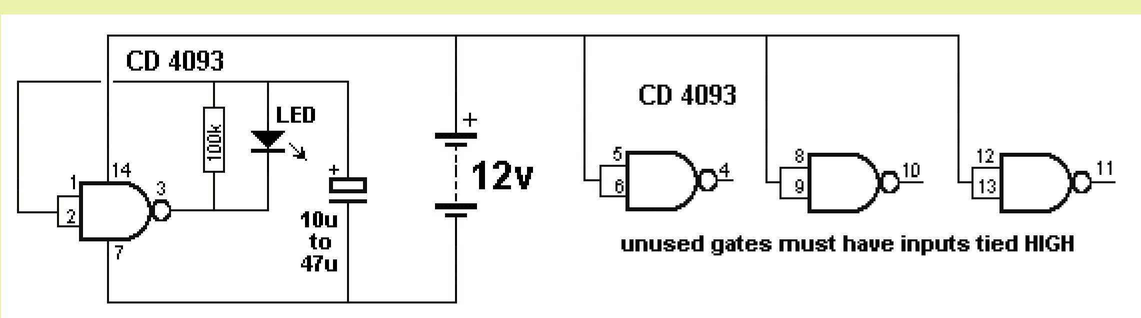


The **Circuit** is simple and can be made match box size. It can fixed to a door, window or car using double sided adhesive tape. The **CD 4093** is a **Quad NAND gate** with 4 identical **Schmitt Trigger gates**. Each gate has two inputs and one output. When both inputs are HIGH, the output goes LOW.

Only one gate is needed for this project. The two inputs are connected together and the output is connected to R2 and the LED. **Capacitor C1** charges through resistor R2. Since R2 is a high value, the charging current will be low (around **50 microamps)**. During this time, LED will be off. When C1 charges to 66% of the supply, the gate changes state and the output goes LOW. The **stored energy** in the capacitor **lights** the **LED**. The flash rate depends on the value of R2 and the brightness depends on the value of C1. If a **high bright red** transparent LED is used, the flashes are visible even in day light. Resistor R1 reduces the current to the circuit to prevent current loss from the battery. **This is untrue. The unused inputs are tied HIGH and the chip gets its charging current via the inputs. You can remove the supply to pin 14 and the chip works exactly the same. This is normally NEVER done.**

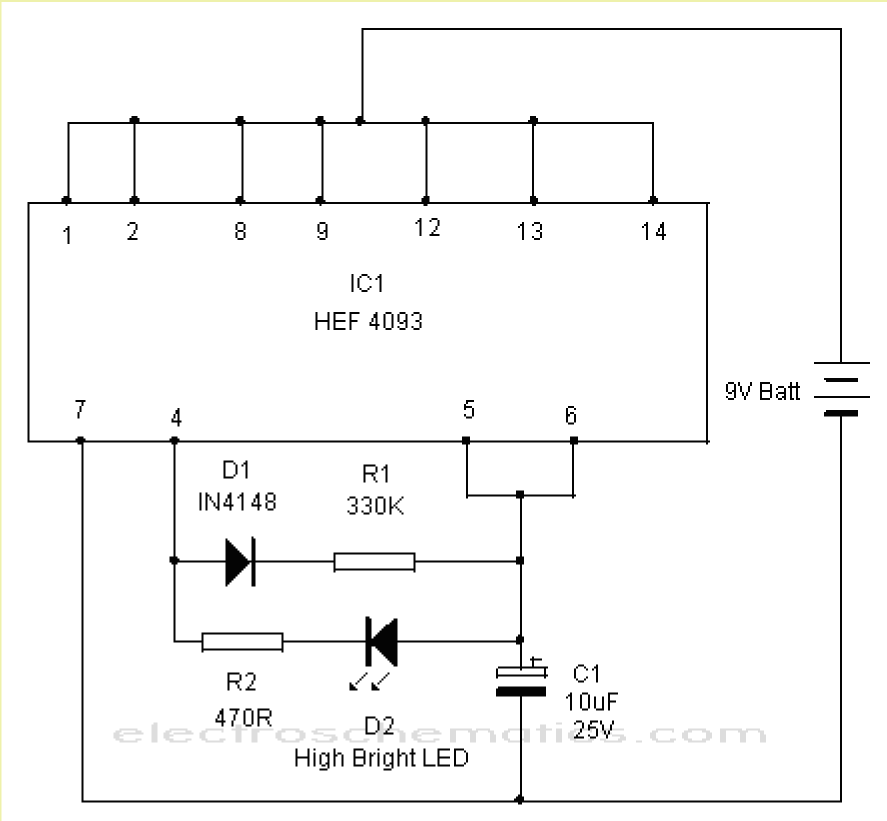
It is important to note that all the inputs and outputs of the **unused gates** should be connected to the **positive** rail to prevent floating. **This is entirely UNTRUE. You must NEVER connect the outputs to either rail - only the inputs to the POSITIVE RAIL**

The circuit above is very poorly drawn. You cannot work out what the chip is doing.
The following circuit has an improved layout:



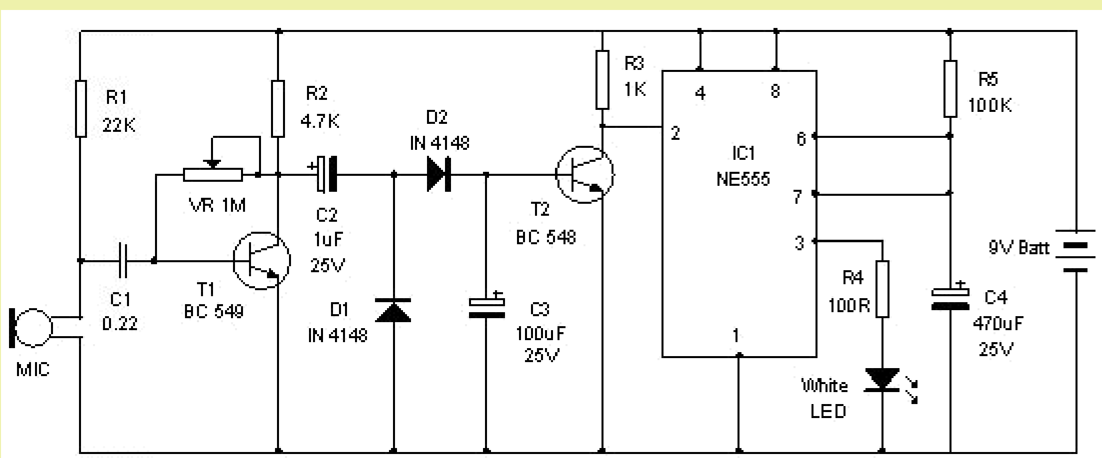
Tying the inputs HIGH reduces the current by as much as 70%

The original circuit has been copied from the following circuit:

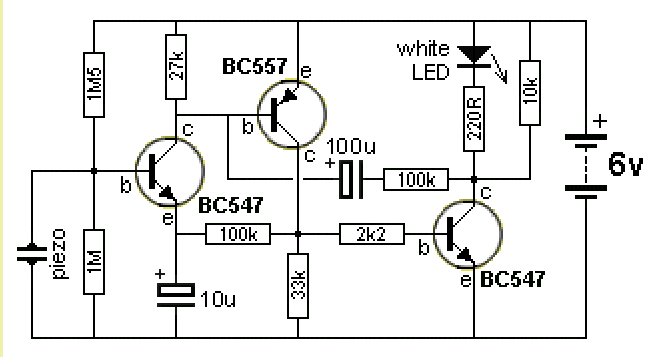


The circuit above can be simplified as the 1N4148 diode is not needed. It is designed to prevent discharging the electrolytic when the gate changes state, but the flash rate is very brief and the 330k will have no effect on discharging the capacitor.
The 470R is not needed as we want all the energy from the electrolytic to drive the LED.

Another faulty design by D.Mohan Kumar The main fault is the circuit takes 10mA via the 555 when sitting around doing nothing.

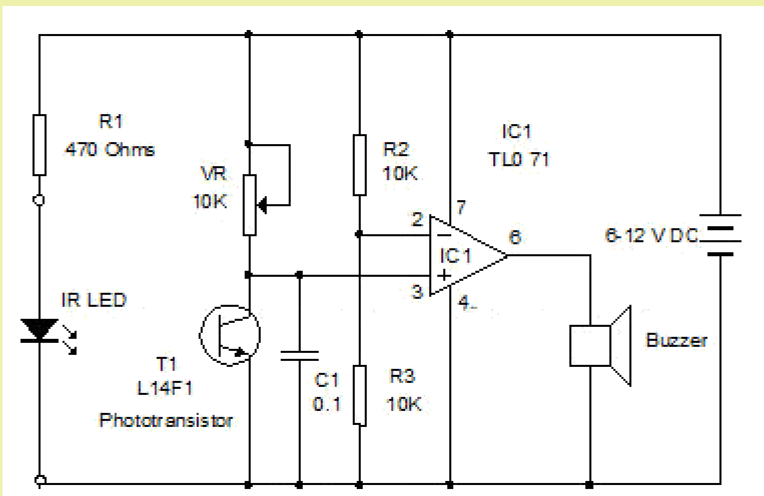


A better design uses transistors and the circuit takes less than 20uA.

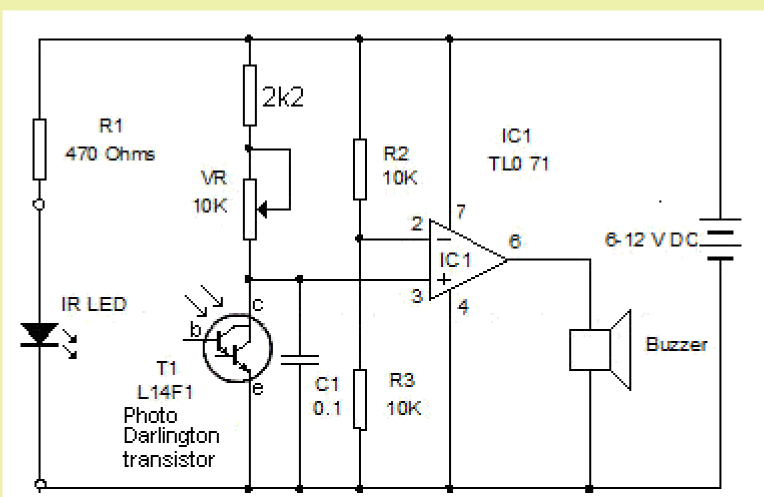


The LED will be illuminated for about 15 seconds via the clap of the hands.
The quiescent current is about 20uA, allowing 4 AA cells to last a long time.
The circuit takes about 20 seconds to reset after the LED goes out. The 100u discharges through the 27k, 100k and 10k resistors.

Another faulty design by D.Mohan Kumar The main faults are the lack of a "Stop Resistor" on the Photo Darlington transistor and the wrong symbol for the transistor.

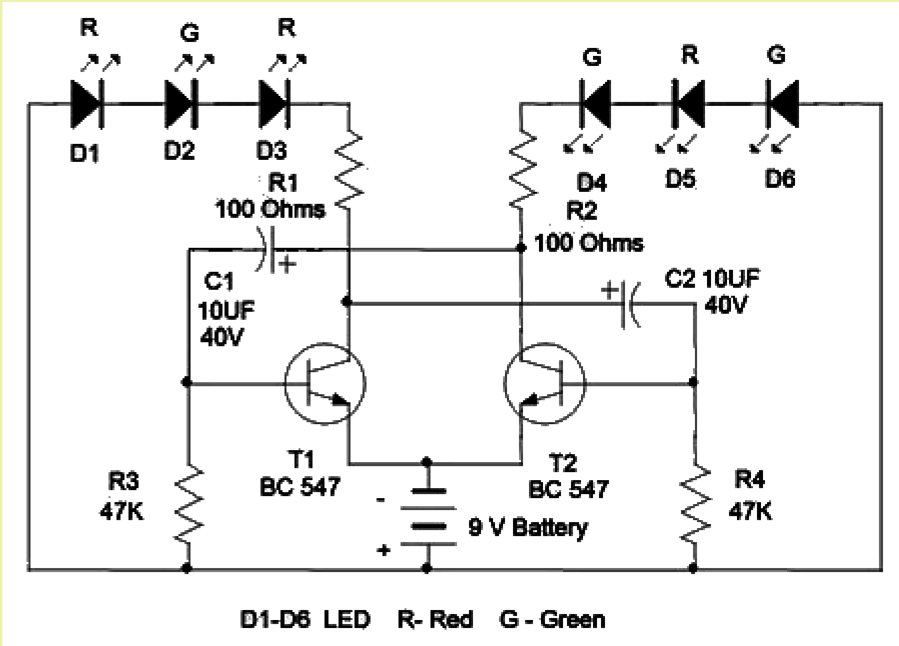


IR Beam Alarm



The circuit can be set-up on one side of a doorway to detect persons entering or leaving a premises. The other side of the doorway should have a mirror to reflect the beam. The piezo buzzer is an active device with a transistor drive-circuit enclosed in the unit. It produces a tone when a voltage is applied.

Another design by D.Mohan Kumar The main fault is the unusual layout. Every type of circuit has a prescribed way to lay it out. This allows you to instantly recognise the type of circuit.
He is his layout:

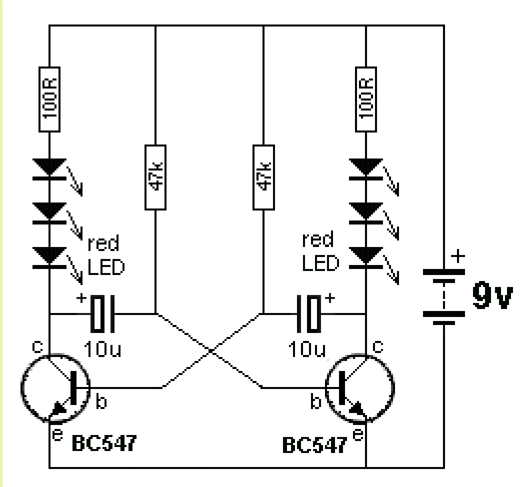


Here is his terrible description of how the circuit works. Remember, he is a University Professor in India with 20 year's teaching experience and has presented over 200 circuits to all sorts of magazines in India. His description is completely flawed and meaningless. It is the worst description I have ever seen. It teaches nothing and leaves out the important functions of how the circuit changes state. It is no-wonder Indian students have no understanding of how circuits work. The teachers themselves are confused.

Here is a simple Dancing LED circuit. The LEDs turn on/off alternately giving a dancing appearance. It is a simple astable multivibrator using two NPN transistors. It works on a principle of charging and discharging capacitors C1 and C2. Current from the positive of the battery flows through the first set of LEDs D1 - D3 to the collector of T1 through resistor R1. Resistor R1 limits current through the LEDs to protect them. The current through R1 charges capacitor C2. It then discharges through the base of T2 and resistor R4. This gives base current to T2 and it conducts. As a result, the second set of LEDs D4 - D6 light as the current flows through T1. Capacitor C2 again charges and the cycle repeats.
The same thing happen on the other side. This gives alternate flashing of the LEDs.

This description is utter rubbish. No-where does he mention the charging of C1.

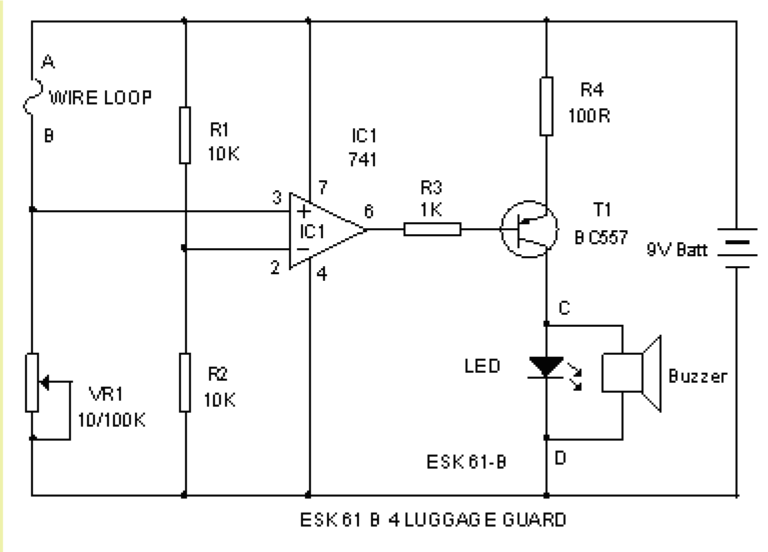
It is very difficult to see what the circuit is doing, when it is drawn incorrectly.
All circuits need to be drawn correctly so it is easy to see what it is doing.
When it is drawn correctly, you can see it is an astable (non-stable - free running) multivibrator.



Here's how the circuit works:
When the power is applied, both transistors have 47k resistors connected to the bases and **both** will start to come on. But one transistor will come on slightly faster than the other. This is called "racing" and the transistor that comes on slightly faster will pull the positive lead of the uncharged 10u towards the negative rail and this will reduce the turn-on voltage to the other transistor.
We now have the case where the left transistor is tuned ON via the second 47k and the left three LEDs are illuminated.
How, here the part that no-one has mentioned before.
The first transistor is also turned on by the second 10u charging via the three LEDs and 100R. This add to the turn-on of the transistor and adds to its "saturation" In other words it is tuned on more than just the effect of the 47k resistor.
This causes the collector-emitter voltage to be very low.
During this time the first 10u electrolytic is also charging (in reverse) and the second transistor is starting to see base-emitter voltage.
The second 10u is getting nearly fully charged and the "charge-current" starts to reduce.
This turns off the first transistor very slightly and the collector voltage rises. The positive end of the 10u rises and takes the negative lead higher. This action starts to turn on the second transistor and the collector voltage falls. The positive lead of the second 10u falls and takes the negative lead lower. This starts to turn off the first transistor and the first 10u rises to turn on the second transistor. This is how the two transistors change state.
We mentioned the first 10u was initially charged in the reverse direction by about 0.5v as the positive end was 0.2v about the 0v rail and the negative lead had about 0.7v on it.
When the first transistor turns off, the positive lead rises due to the characteristic volt-drops of the three LEDs and it starts to charge with a high current. This current firstly discharges the electro and starts to charge it in the other direction. This fully saturates the second transistor and makes the collector-emitter voltage very low.
As the charging current reduces the second transistor becomes less tuned-on and the collector-emitter voltage rises. As we said above, this is how the two transistors change state.

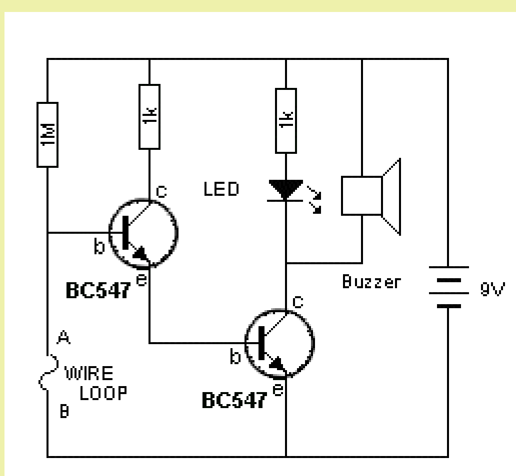
This description is a far-cry from Professor Mohan Kumar's understanding of the issue.
The operation of this type of circuit is much more complex than you think.

Here's Another stupid design by D.Mohan Kumar
Here is is his description. He has absolutely no concept of how to explain the operation of the circuit.
This simple circuit can protect your luggage. It gives a loud warning beep when somebody tries to take your luggage.
A thin wire loop is used to keep the alarm off in standby mode. Preset VR1 is used to adjust the voltage at pin 3 of IC1 **(this is NOT true - how can you adjust a voltage when a wire loop has zero resistance)**.
IC1 is used as a comparator. Its non inverting input (pin3) is connected at the junction of wire loop and VR1. Its inverting input (pin2) is connected to a potential divider comprising R1 and R2 which gives half supply voltage (4.5 V) to the inverting input. Output of IC1 is connected to the base of PNP transistor BC 557 through the current limiting resistor R3. Resistor R4 limits current to the LED and Buzzer.



Normally current passes through the wire loop to pin 3 of IC1. So pin3 of IC1 gets more current than pin2. **(this is NOT TRUE)** This makes the output of IC1 high. The high output from IC1 inhibits the transistor from conducting. So LED and buzzer remain off. When somebody takes the luggage, wire loop breaks and current to pin 3 drops **(The inputs are voltage controlled - not current controlled).** As a result voltage at pin 3 becomes zero and the output of IC1 becomes low. This allows T1 to conduct and buzzer sounds and LED lights. Tie the wire loop around the luggage so it breaks when the luggage is pulled.

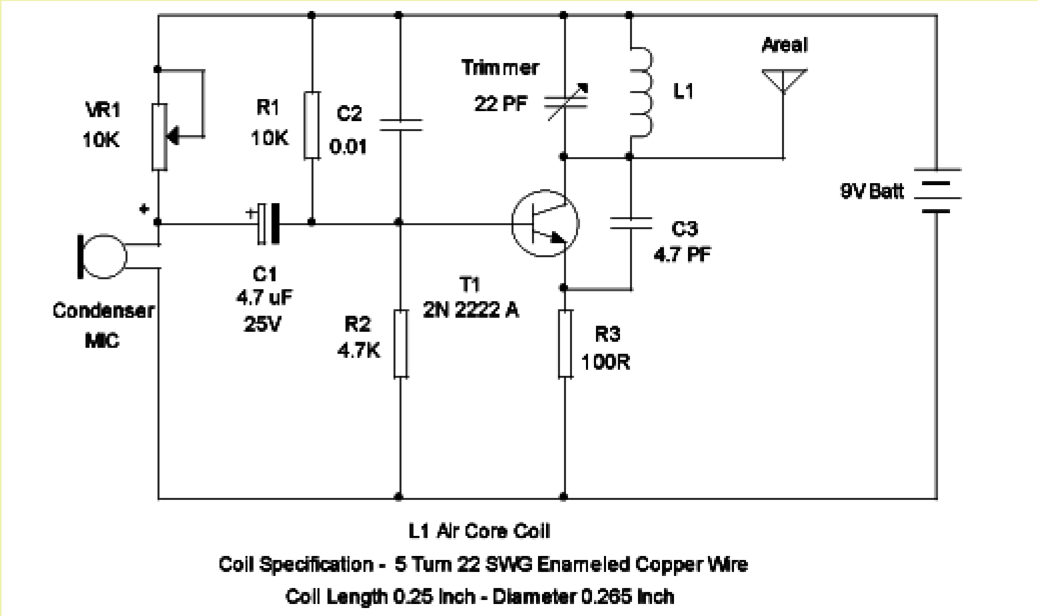
The circuit above is over-designed, and it has a major fault. If the 10k pot is turned fully, it will create a short-circuit with the wire loop. In addition, the circuit takes a high current when not doing anything. In addition, the buzzer will never work as it sees only 1.8v.
This circuit has never been tested and Professor D.Mohan Kumar should stop making a fool of himself by publishing such rubbish on his website. It's no wonder Indian students look to overseas to get an education.
Half of Talking Electronics 9GB of traffic each day comes from India. It is unbelievable how India is advancing in this technological age.
I get emails from Indian businessmen who was to make cheap LED lights for villagers who don't have electricity, so you can see the enormous range of social benefits in this country.
On the other hand I see Indian lecturers on videos trying to teach electronics. I can hardly understand what they are trying to present. It's no wonder students don't understand.
Now, back to the answer for this circuit:
All that is required is two transistors and three resistors, as shown in the circuit below:



LUGGAGE GUARD

Here's Another disaster by D.Mohan Kumar

He claims to test all his circuits. This is one of the poorest designs for an FM transmitter. See our article Spy Circuits for a full description of how to design this type of circuit.
Remember, this is a University Professor from India, describing the circuit. It is the most inaccurate description I have come across and quite a useless design as far as FM transmitters are concerned. .



Here is his wording for the details of each component.

1. Condenser MIC

The condenser MIC is used to pick up the sound signals. The diaphragm inside the MIC vibrates according to the air pressure changes and generates AC signals. **(He does not mention anything about the FET transistor inside the case. He knows nothing about this type of microphone).** Variable resistor VR1 adjusts the current through the MIC and thus determines the sensitivity of MIC. **(If the 10k is turned fully it will completely damage the microphone. Very dangerous. A very poor design)**. The condenser MIC should be directly soldered on the PCB to get maximum sensitivity **(rubbish)** . Sleeving the MIC inside plastic tubing can increase its sensitivity enormously.

2. Decoupling Capacitors

C1 is the first decoupling capacitor **(It is a coupling capacitor not a decoupling capacitor)** impedes the different frequencies of speech signals. **(not an accurate description)**. C1 modulates the current to the base of transistor. The 4.7 uF capacitor isolates the microphone from the base voltage of the transistor and only allows alternating current (AC) signals to pass.
A large value capacitor induces bass (low frequencies) while a low value one gives treble (high frequencies). Capacitor C2 (0.01) act as the decoupling capacitor **(not really. It actually couples the base to the rail)**. Capacitor C3 across the transistor T1 keeps the tank circuit vibrating. As long as the current exists across the inductor coil L1 and the trimmer capacitor, the tank circuit (coil-trimmer) will vibrate **(oscillate)** at the resonant frequency. When the tank circuit vibrates for long time, the frequency decays due to heating **(the losses are due to magnetic losses and losses in charging and discharging the capacitor).** Presence of the capacitor C3 prevents this decay. A capacitor between 4 and 10 pF is necessary. **(Poorly presented and reasonably inaccurate - he has not told you anything).**

3. Resistors

Variable resistor VR1 restricts the current through the MIC. The voltage divider R1 and R2 limits the base current of T1 **(not really - it puts 3v on the base)** and R3 forms the emitter current limiter. The given values are necessary for the 2N 2222A transistor. **(He has not mentioned the transistor is a common-base stage).**

4. Transistor

2N 2222A is the common NPN transmitter used in general purpose amplifications. It has maximum power rating of 0.5 Watts. Over-powering of 2N 2222A can generate heat and destroy the device. So maximum power output should be around 125 milli watt. **(the output of this circuit is about 30mW)**

5. Inductor Coil

The inductor used in the circuit is a hand-made coil using 22 SWG (Standard Wire Gauge) enameled copper wire. The length, inner diameter, number of turns etc are the important values to be considered while making the inductor. Then only the inductor resonates in the 88-108 band FM frequency. **(badly worded).** For this circuit, the coil radius was selected as 0.26 inches (outer diameter) and 0.13 inner diameter. Coil can be wound around a screw driver (with same diameter) to get a 5 turn coil of 0.2 inch long. Remove the coil from the screw driver and use the 5 turn air core coil. Remove the enamel from the ends and solder close to the transistor.

6. Trimmer capacitor

A small variable capacitor with a value of 5 -22 pF can be used to adjust the resonant frequency of the tank circuit. The variable capacitor and the inductor coil form the tank circuit (LC circuit) that resonates in the 88-108 MHz. In the tank circuit, the capacitor stores electrical energy between its plates while the inductor stores magnetic energy induced by the windings of the coil.
Tank Circuit
Every FM transmitter needs an oscillator to generate the radio Frequency (RF) carrier waves. The name 'tank' circuit comes from the ability of the LC circuit to store energy for oscillations. The purely reactive elements, the C and the L simply store energy to be returned to the system **(badly worded).** In the tank (LC) circuit, the 2N 2222 A transistor and the feedback 4.7 pF capacitor are the oscillating components **(badly worded).** The feedback signal makes the base-emitter current of the transistor vary at the resonant frequency **(badly worded).** This causes the emitter-collector current to vary at the same frequency. This signal is fed to the aerial and radiated as radio waves.

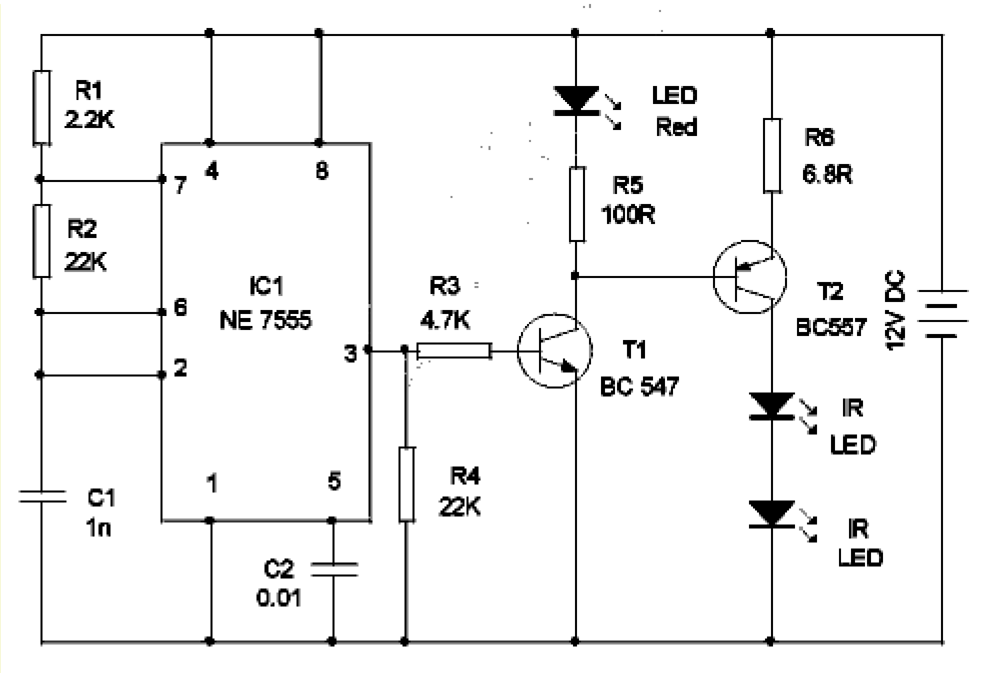
FAULTS

Apart from the 10k pot damaging the electret mic, the circuit needs a 22n across the battery. This improves the output considerably.
The 10k and 4k7 voltage-divider resistors put 3v on the base and the transistor operates in the range of about 3v. Using a 9v supply is a complete waste of voltage. The circuit will work with a 3v battery and a single 47k base resistor.
The 4u7 can be 100n with no difference in quality.
The 100R emitter resistor is too low. It should be 470R.
Overall a terrible copy of a single transistor FM transmitter that can be found on the web with fewer mistakes than is design.
See our article Spy Circuits for better FM transmitters.

Here's another disaster from Professor D.Mohan Kumar who knows nothing about electronics' design:

20 kHz IR Transmitter

This continuous tone IR transmitter can be used in **Broken Beam Detector** system to activate an alarm. The circuit is a simple multivibrator and an IR LED driver output. This transmitter is useful in Photodiode and Phototransistor based IR receivers.



Faulty 20kHz transmitter - do not construct!

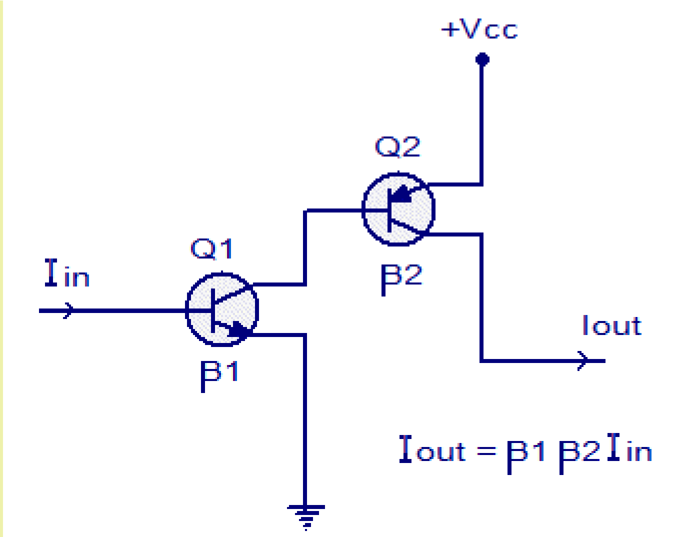
IC1 is designed as a simple oscillator using the components R1, R2 and C1. With these components, output pulses will be around 20kHz. The effective range of the IR beam depends on the peak current to the IR LED rather than the mean current. Around 100-200mA current is necessary to increase the transmitting range. Hence the output pulses from IC1 are fed to a LED driver circuit comprising T1 and T2. When output of IC1 is high, T1 is driven into saturation via R5 and red LED turns on. When T1 conducts, T2 turns on to drive the IR LEDs. When the red LED turns on about 1.8 volts develop across the LED and around 1.2 volts develop across R6 **(10.2v develops across the 100R resistor - this is the BIG MISTAKE!)**. Thus T2 acts as a constant current generator **(NO . ... IT DOES NOT)** and with R6, the peak current flowing through IR LEDs is around 170 - 200mA (1.2 / 6.8 =0 .176 A or 176 mA) **(The calculations are WRONG!!!! The current though the IR LEDs will be more than one AMP!!!! They will be DAMAGED!!!)** When the output of IC1 goes low, T1 and T2 turns off and IR LEDs switch off. IC1 is the CMOS low power version of 555 IC. It works on 5 -15 volts DC.

More faults:
1. The circuit may not turn off as the 7555 goes low but not below 0.6v.
2. What is the function of the 22k. It should be on the base of the BC547 transistor.
3. C2 is not needed.
4. 6R8 is too low. It will instantly damage the IR LEDs.
5. Both transistors will be instantly damaged when the circuit turns ON. The current will be about 1.5 amps!! - through the 6R8 and emitter-base of the BC557 and collector-emitter of the BC547.

I have contacted Professor D.Mohan Kumar more than 10 times with all his previous faulty circuits, and yet he continues to pump out this RUBBISH on his web pages.
He never tests anything and I don't know why he fails to respond to any of my corrections.
He is just an embarrassment to the electronics industry and it is fortunate we don't have many fools like this in the teaching profession. He is possibly the WORST designer I have come across.
At least he provides a platform for the rest of us to study and learn.
Remember - don't make a fool of yourself. Test everything before you release it.
I have things sitting on the bench at the moment - turning ON and turning OFF to the sounds of the TV - just to prove a circuit works over a long period of time and remains working when the battery voltage reduces.

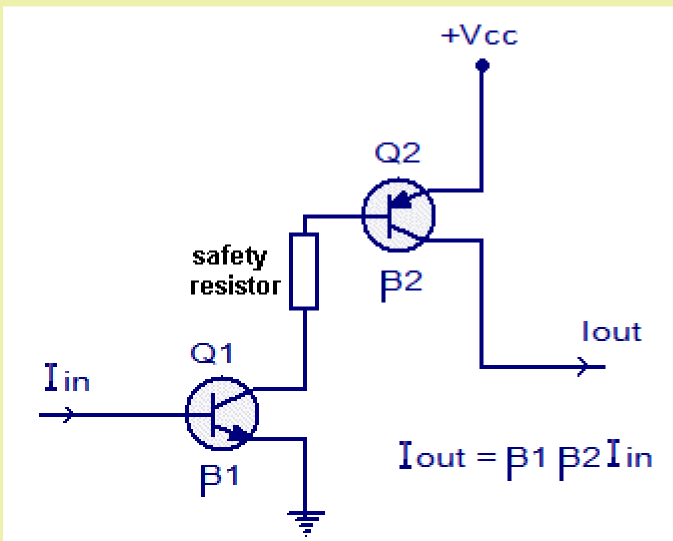
Here's another circuit from: http://www.circuitstoday.com/

Never connect two transistors so that current can flow from the positive rail to the 0v rail via the junctions of the transistors. If you supply sufficient current into the base of the first transistor, a larger current will flow via the collector emitter leads of Q1 and this current will flow from the emitter to base junction of Q2. This current can overheat and damage the transistors.



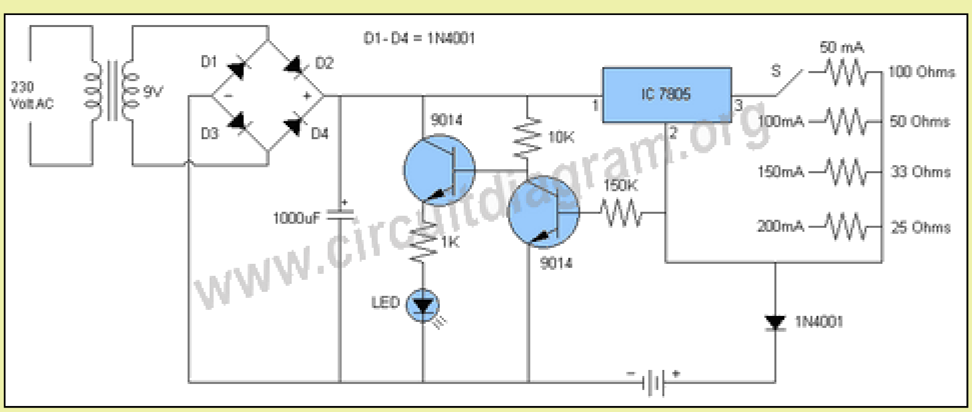
Current amplifier using transistors

The answer is to add a resistor called a SAFETY RESISTOR as shown in the following diagram. The resistor will not alter the performance of the circuit but it will limit the maximum current:



Current amplifier using transistors

Here's a circuit from **CIRCUIT DIAGRAM.ORG** The website is owned by: Salman Feroz Ali from Karachi   Pakistan
http://circuitdiagram.org/automatic-nimh-battery-charger-circuit.html

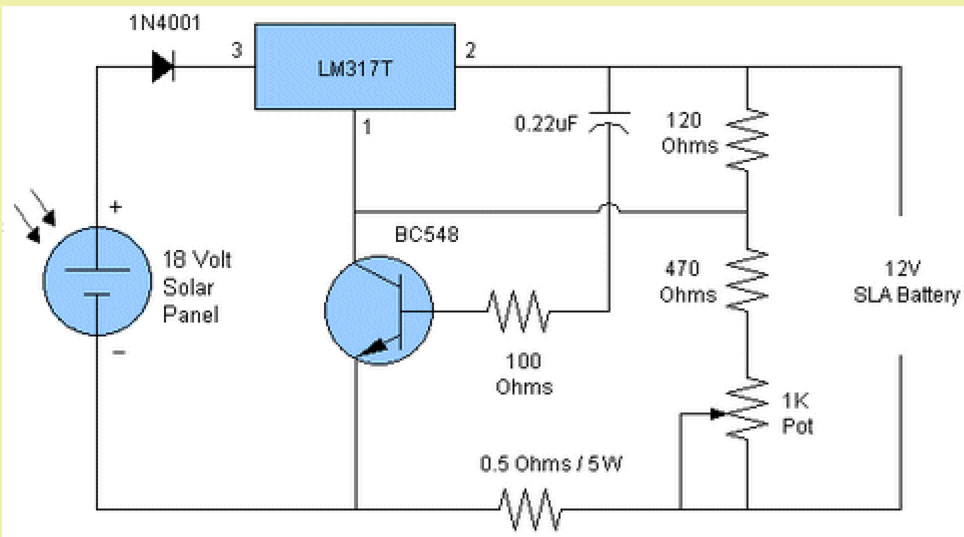


Here is his description of the circuit:

The diagram is a fully automatic NiMH battery charger circuit using a 7805 voltage regulator which is providing a constant current to charge 2 NiMH cells. The LED works as a charging indicator so when the cells become fully charged the LED will go off. The circuit can charge two NiMH cells at a time. The circuit has four different current sources: 50mA, 100mA, 150mA and 200mA which is selectable with the switch S, so you can choose the current source for your cells. For example if you want to charge 500mA NiMH rechargeable cells you have to select 50mA current, for 1000mAh NiMH cells select 100mA, for 1500mAh select 150mA and to charge 2000mAh cells select 200mA.

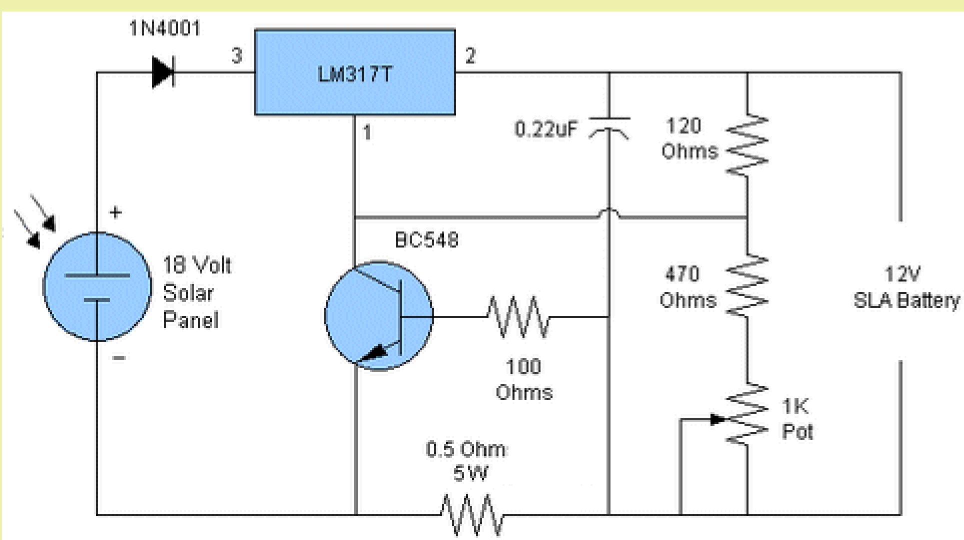
The only problem is the LED will never illuminate. The second transistor is always ON. The circuit cannot detect the exact voltage when the two cells are charged. Since the charging current is about 1/10th the rating of the cells, it will take about 14 hours to fully charge flat cells.

Here's another circuit from **CIRCUIT DIAGRAM.ORG** The website is owned by: Salman Feroz Ali from Karachi Pakistan



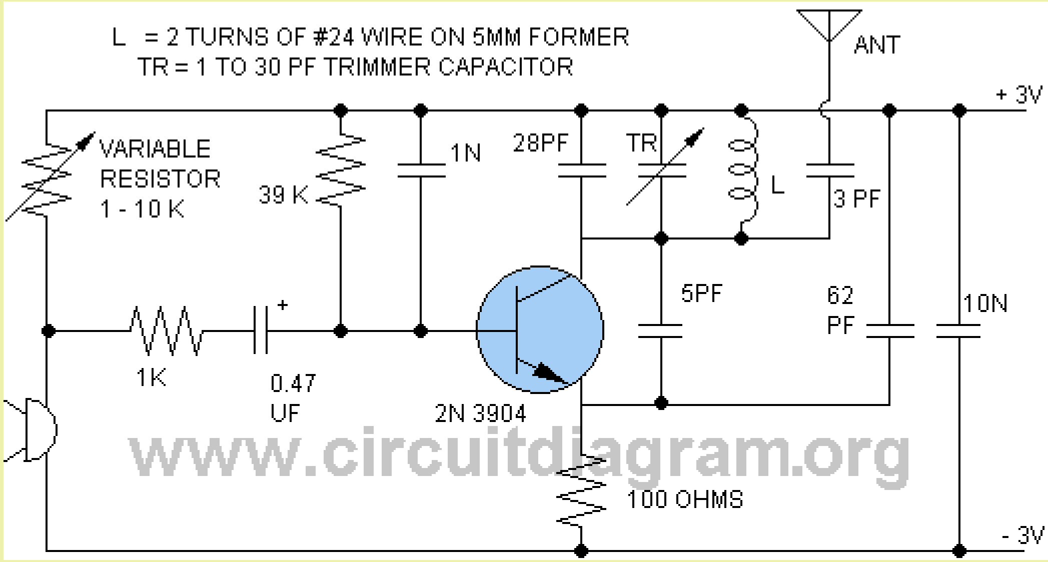
The base of the transistor is connected to a 220n capacitor. How does the transistor work?

I think the circuit is supposed to be:



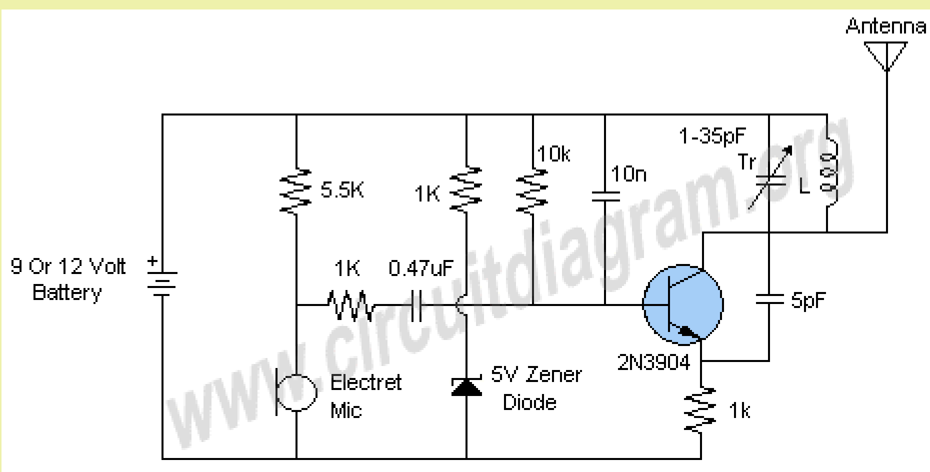
Here's another circuit from **CIRCUIT DIAGRAM.ORG** The website is owned by: Salman Feroz Ali from Karachi Pakistan. His whole website is filled with faulty circuits. They provide a good lesson on how NOT to design a circuit.

Here is an FM Transmitter. I have listed the faults with the circuit. You can see a discussion on FM transmitters HERE.



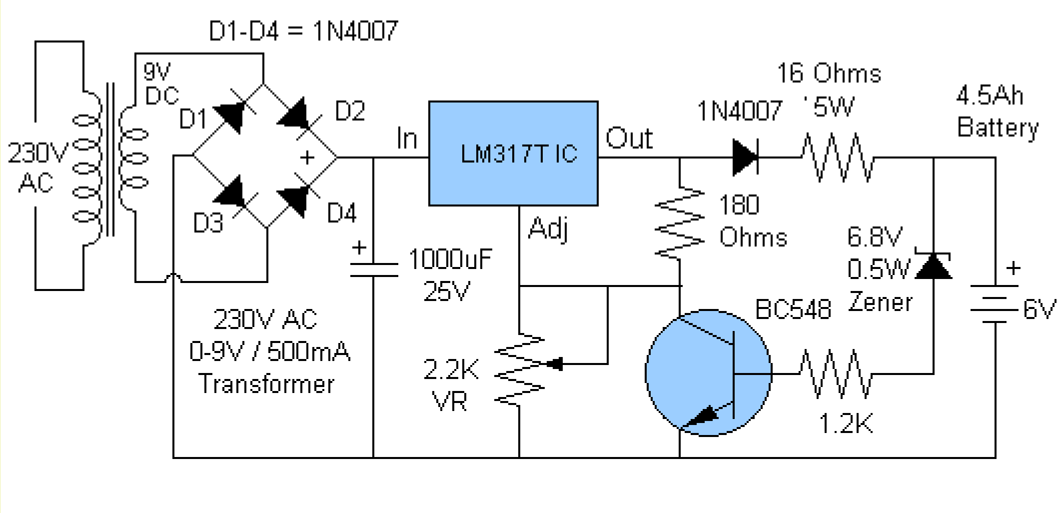
1. The symbol for a microphone is a carbon microphone. These are no longer available. The symbol should be an electret microphone.
2.Turning the 10k pot fully will destroy the microphone. It should have a 1k "stop resistor."
3.The 1k connected to the 470n does nothing.
4. The coil should be 5 turns on 3mm former. The energy from the coil should match the energy from the capacitor.
5. The 62p does nothing.
6. The 3p on the antenna simply reduces the range.

Here's another circuit from **CIRCUIT DIAGRAM.ORG**



Putting a 1k in series with a 5v6 zener does **absolutely nothing**. It is just wasting current though the zener.

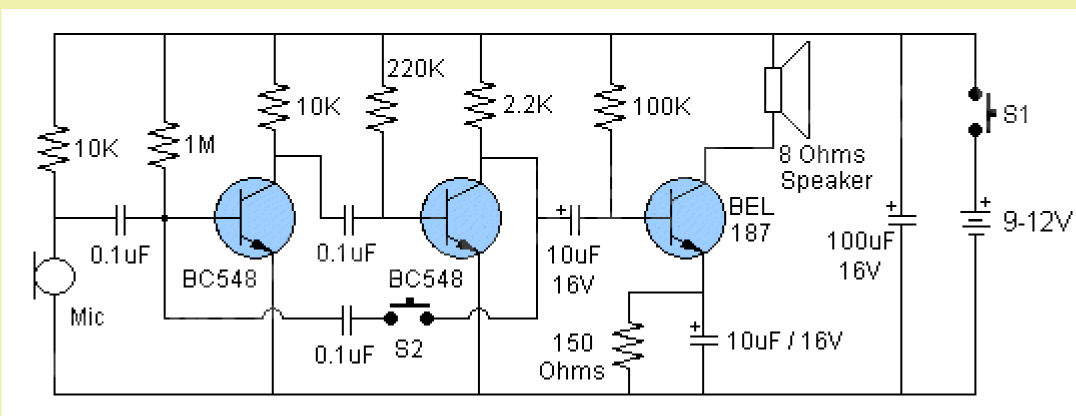
Here's another circuit from **CIRCUIT DIAGRAM.ORG**



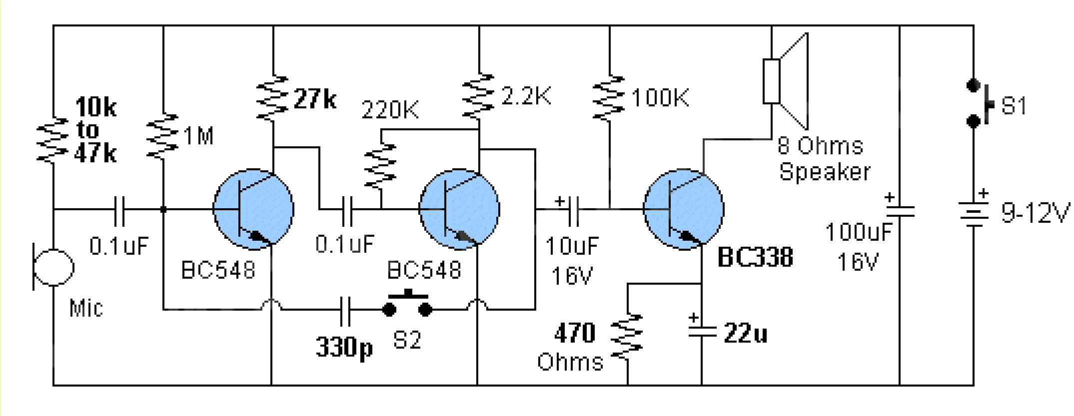
The circuit looks ok, until you work out the voltage available. The supply is 9v DC. Why have a bridge for 9v DC? The voltage into the regulator will be 8v. The voltage out will be less than 7v. The voltage after the 1N4007 will be less than 6.3v. The voltage drop across the 16R resistor will be 1.6v for 100mA charging current. This leaves less than 4.7v. The battery needs at least 7v to start the charging process as the battery quickly generates a "floating charge" (or floating voltage) of 7v. The 9v DC transformer will not work.
A 9vAC transformer will only deliver 150mA as 2.4v will be dropped across the 16R resistor and this uses up all the available 13.5v.
The circuit really needs 12v AC.

Here's another circuit from **CIRCUIT DIAGRAM.ORG**

The Intercom circuit does not work. The main fault is the 220k bias resistor on the base of the second transistor. The value is too low. It should be 1M.

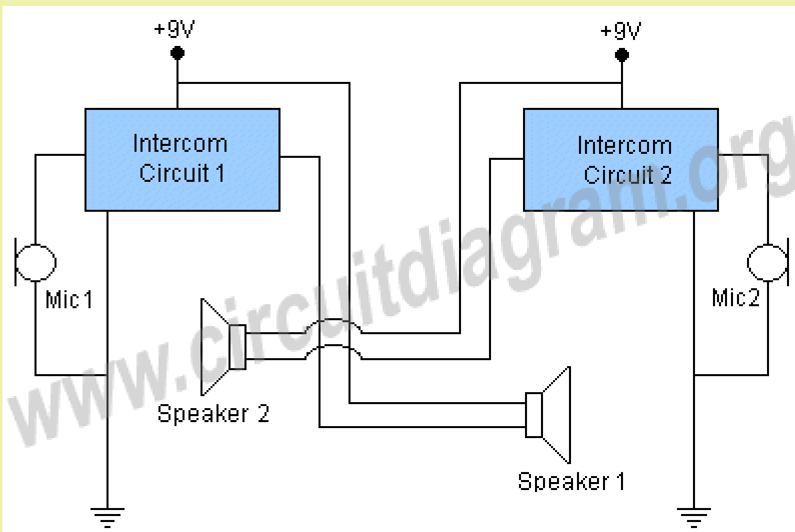


INTERCOM (circuit does not work)



INTERCOM (this circuit works)

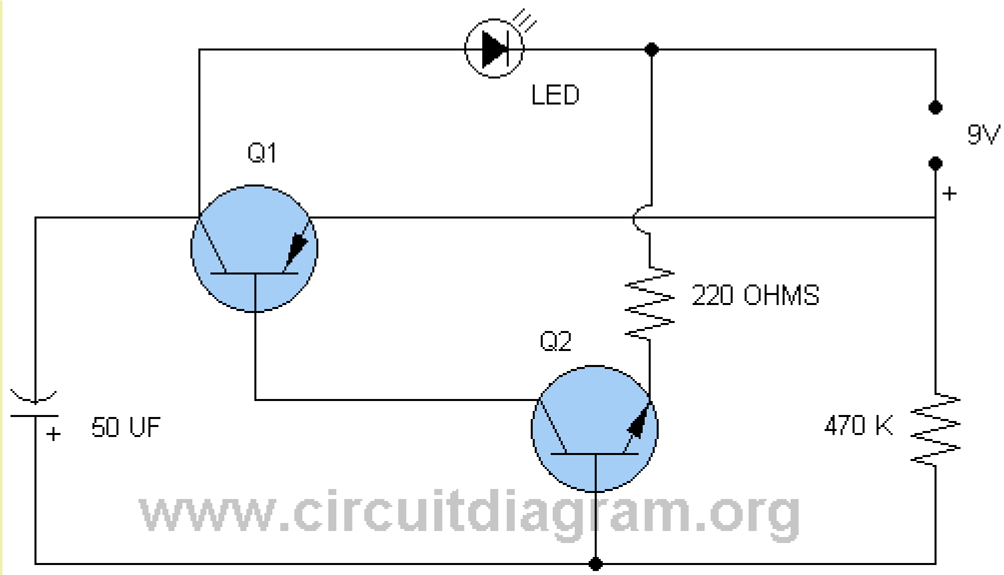
By changing the position of the base resistor on the second transistor to create self-bias, the circuit became very sensitive and you could hear a pin drop.
The 100n feedback capacitor must be reduced to 330p to produce the call-tone.
The other changes were only minor and the 470R on the output transistor reduced the quiescent current from 25mA to 15mA.



Connecting two intercom circuits to produce two-way talk

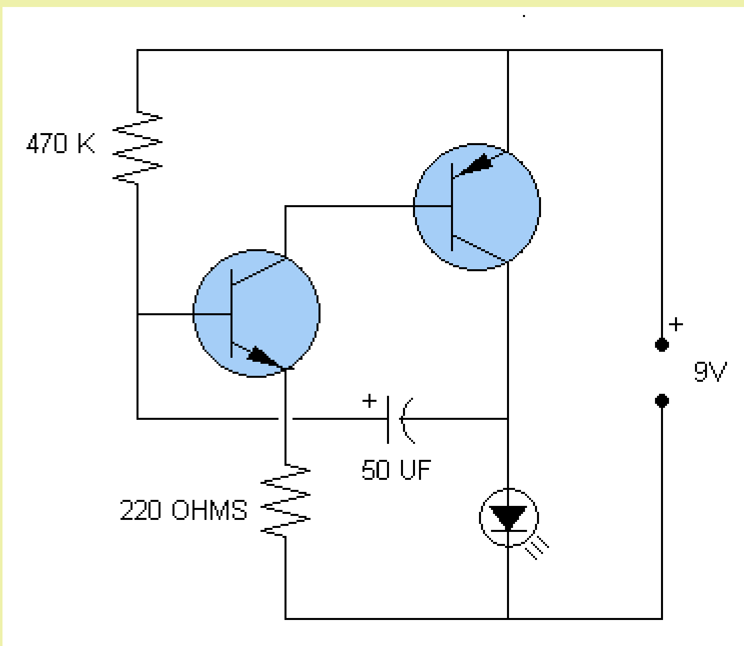
Here's another circuit from **CIRCUIT DIAGRAM.ORG**

The circuit works but the layout needs to be changed so it conforms with "standard layout."



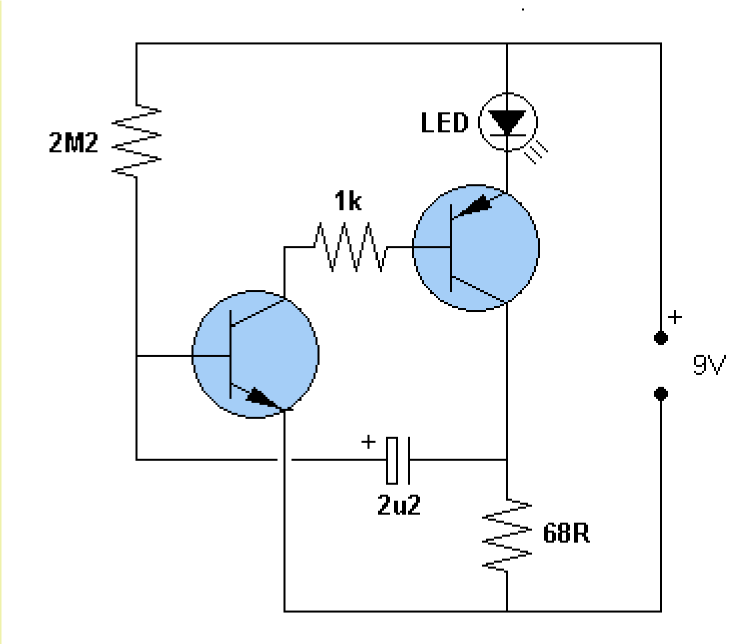
THIS CIRCUIT DOES NOT WORK!

We can now see the LED does not have a dropper resistor and will be instantly damaged:



THIS CIRCUIT DOES NOT WORK!

But the circuit above DOES NOT WORK.
The circuit must be redrawn as follows:



THIS CIRCUIT WORKS!

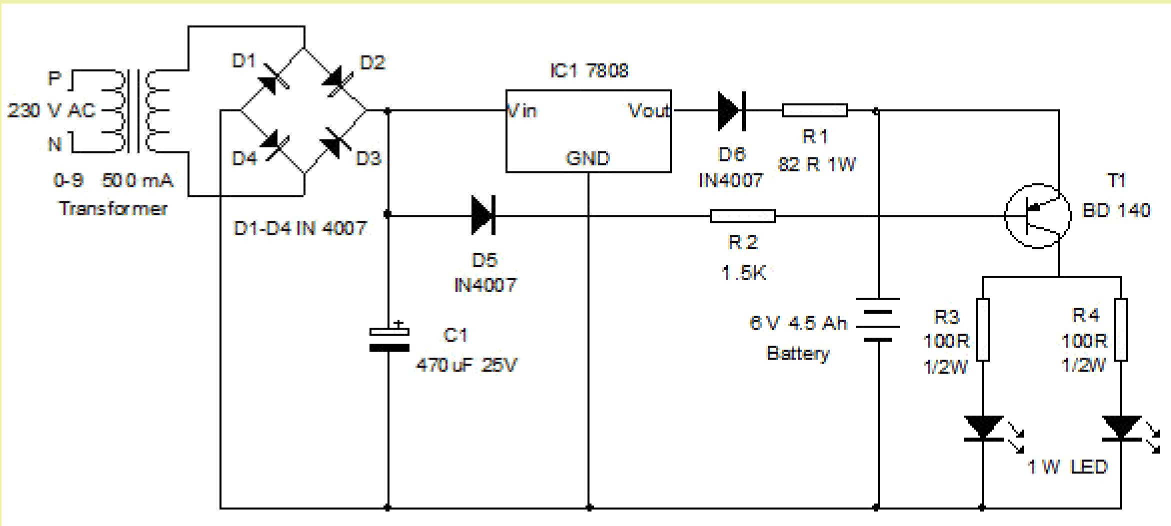
The circuit works on the basis of a high-gain amplifier being driven into saturation (fully turned-on), firstly by the very small amount of current delivered by the 2M and then from energy stored in an electrolytic. When the energy from the electrolytic has been fully delivered, it cannot keep the amplifier fully turned on and it turns off slightly. This action removes the "turn-on" effect from the electrolytic and the amplifier begins to turn off. This action continues until the amplifier is fully turned off and is kept in the off state while the electrolytic begins to charge. The off-state is very long and the on-state is very short. This is how the LED produces a brief flash.

Here is the technical description of the operation of the circuit:
When the supply is connected, both transistors are off and the 2u2 electrolytic charges via the 2M2 resistor and 68R. When the voltage on the base of the first transistor rises to about .6v, it begins to turn on and the resistance between its collector-emitter terminals is reduced. This allows current to flow in the collector-emitter circuit of the second transistor via the 1k resistor. The second transistor conducts and the LED is illuminated. The current through the LED is limited by the 68R resistor and at this point in the cycle a voltage is developed across the 68R. The negative end of the electrolytic is "jacked up" by this voltage and the positive end pushes the charge on the electrolytic into the base of the first transistor to turn it on even harder. In a very short time all the energy in the electrolytic has been delivered and it cannot hold it ON any longer. The transistor turns off slightly and this has the effect of turning off the second transistor a small amount. The LED begins to turn off and the voltage across the 68R reduces. The negative lead of the electro drops a small amount and so does the positive lead. This action continues until the first transistor is fully turned off. This turns off the second transistor and the LED is extinguished. The cycle starts again by the 2u2 charging. The charge-time is considerably longer than the discharge time and this gives the LED a very brief flash.

Why doesn't the original circuit work?
The 50u is connected to the top of the LED. When the two transistors start to turn off, the negative end of the electrolytic has to be pulled to the 0v rail and this will pull the positive lead down too. The "pulling-down" effect has to be greater than the charging provided by the 2M2 so the two transistors get fully turned off.
In the original circuit, the LED can only pull the right lead down to 1.7v and this allows a turn-on voltage to exist on the base of the first transistor. The transistor remains ON and the LED remains illuminated. Two more points to note:
The 2M2 must be a high value otherwise the circuit will not turn off as it will start to charge the electrolytic during the time when it is being "pulled-down."
The 68R cannot be higher than 100R otherwise the circuit will not turn off as the current through this resistor this resistor must be a considerable amount so that the PNP transistor needs a fairly high base current . When the transistor does not get this current, the circuit is able to turn off.

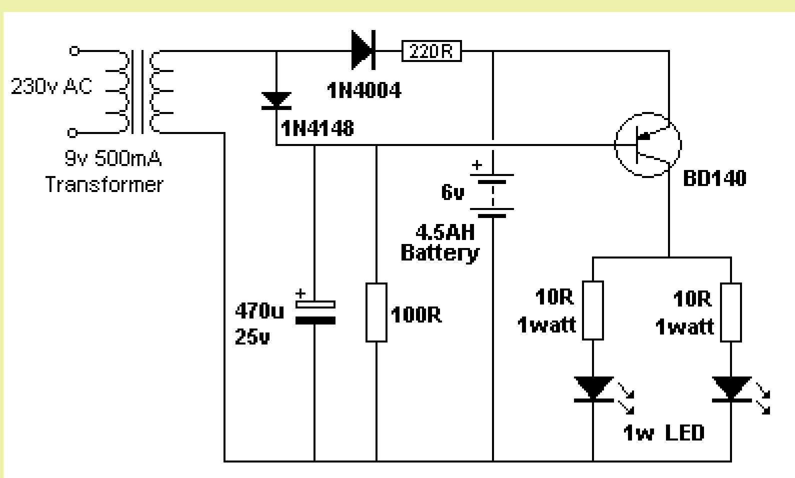
Here's another faulty circuit from Professor D.Mohan Kumar who knows nothing about electronics' design:

He says:
The battery charger section comprises a 0-9 volt 500mA step-down transformer, a full wave bridge rectifier (D1 through D4), a 470u (C1) smoothing capacitor and 7808 voltage regulator IC. IC1 provides regulated 8 volt DC for charging the battery. Resistor R1 restricts the charging current to 100-110mA (wrong).
LED driver circuit uses a medium power PNP transistor BD 140 which acts as an automatic switch. When the mains power is available, battery is charged through D6 and R1. At the same time, voltage from the bridge rectifier passes through D5 and R2 to the base of T1 to inhibit its conduction. So both the LEDs remain off. When the power fails, T1 turns ON and the LEDs turn ON (wrong).



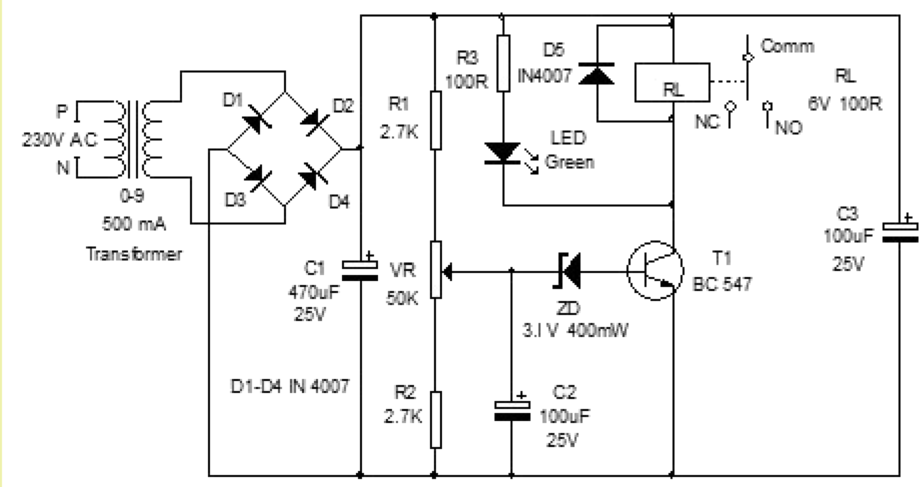
High bright LED Emergency Lamp Circuit

Mistakes in the circuit:
When the power fails, the transistor will never turn ON. D5 will not pull the base of the transistor to 0v rail. The transistor will just be left "floating."
Resistor R1 restricts the charging current to 10mA. It should be 10R. The 100R resistors to the 1 watt LEDs will only allow allow 30mA, or 100mW to the 1w LEDs. R3 and R4 should be 10R 1 watt.
The value of resistor R2 is too high. It will never allow the transistor to pass 600mA.
This circuit has never been tested.
The following circuit is the simplest design needed.



The charging current is about 20-30mA. It will take about 7 days to charge the battery and this will allow illumination for 5 hours, once per week.
A charging current more than 50mA will gradually "dry-out" the battery and shorten its life.
If the project is used more than 5 hours per week, the charging current can be increased.
The 220R charging resistor can be reduced to 150R or 100R.

Here's another circuit from Professor D.Mohan Kumar:

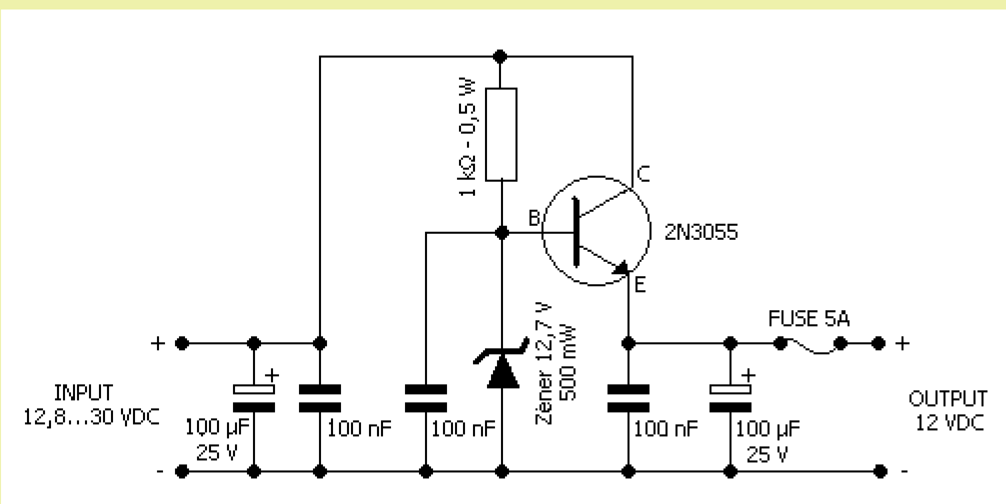


Connect AC Load through Common and NO contacts of Relay

He writes:
This circuit protects home appliances from low voltage. When the voltage in the AC lines drop below the normal voltage, the circuit cuts off power to the appliance and keeps it off till the normal voltage resumes. It is useful to protect appliances like fridges which may over heat if the line voltage drops below 180 volts. Low voltage increases the current consumption in a fridge due to over-stressing the compressor.
The circuit uses a zener controlled relay driver to switch the load. A 9v 500mA transformer provides power for the circuit. Any voltage drop in the primary of the transformer reflects as a corresponding voltage drop in the secondary. So when the line voltage is normal (around 230 volts), the zener conducts to bias the relay driver transistor T1.When T1 conducts (as indicated by the glowing LED), the relay is energized and switches the load ON. The load is connected through the Common and Normally Open (NO) contacts of the relay.
When the mains voltage drops below 200 volts, a corresponding voltage drop occurs in the secondary of the transformer and the zener turns off. T1 then turns off to de-energize the relay. The load remains off till the line voltage increases to normal.
Capacitor C1 gives a short lag before the zener switches to avoid false triggering of T1 if the line voltage fluctuates.
It is necessary to adjust the trigger point using the preset VR. Check the line voltage and if it is above 200 volts, slowly adjust the wiper until the LED turns on and the relay energizes.

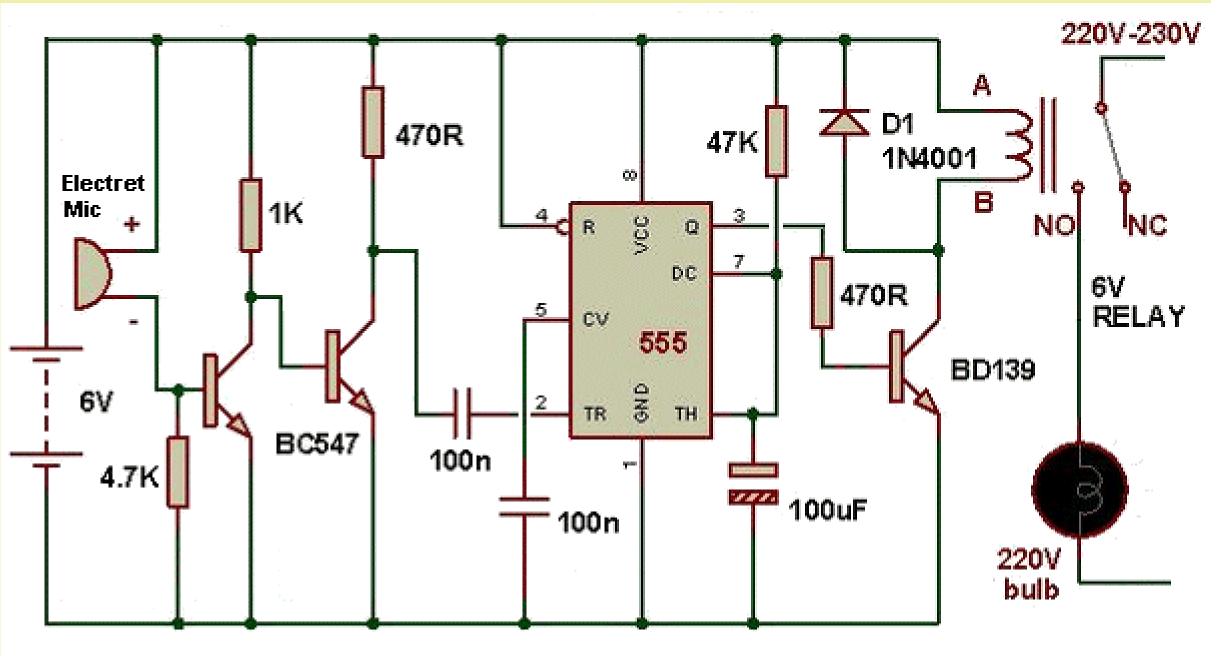
Three faults/improvements are:
1. The zener diode is not needed.
2. R2 is not needed.
3. C3 is not needed.

Here's a REGULATOR circuit that has not been tested:



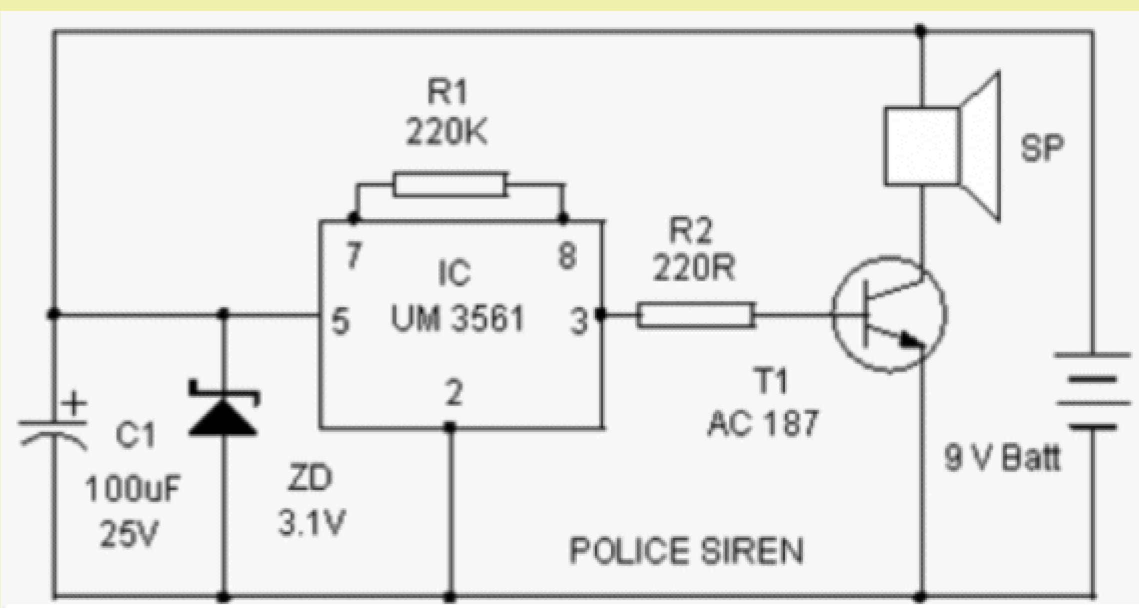
At 12.8v input the voltage across the 1k base-bias resistor will be 0.1v. The current through the resistor will be 0.1mA. If the transistor has a gain of 100, the output current will be 10mA !!!
At 20v input, the output current will be 800mA.
The 5 amp fuse will not protect anything.

Here's a CLAP SWITCH with a few problems:



The electret mic should not be connected to the base without a load resistor.
Pin 2 of the 555 should have a 1M resistor to the positive rail to prevent false triggering. Pin 2 is high impedance and it is not capable of charging or discharging the 100n.

Another faulty circuit from Professor D.Mohan Kumar:

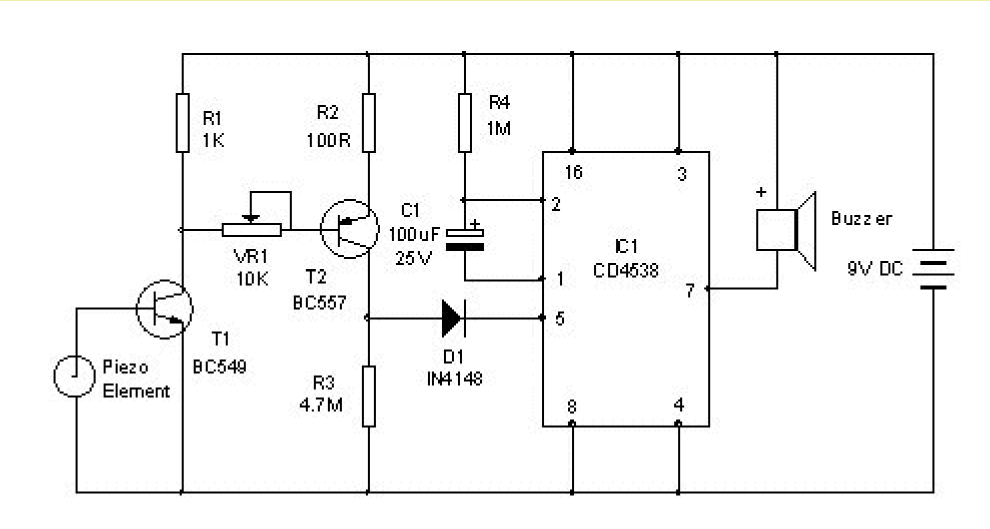


1. The 3v1 zener is connected across the battery !!!
2. Where can you get a 3v1 zener????
3. Where can you get AC187 ? They have not been manufactured for 15 years!!
4. They cost $5.00 each !!!!!! Plus postage
5. What is the impedance of the speaker?

This is another untried circuit from Professor D.Mohan Kumar. He keeps pumping out worthless circuits and destroying the value of the internet.

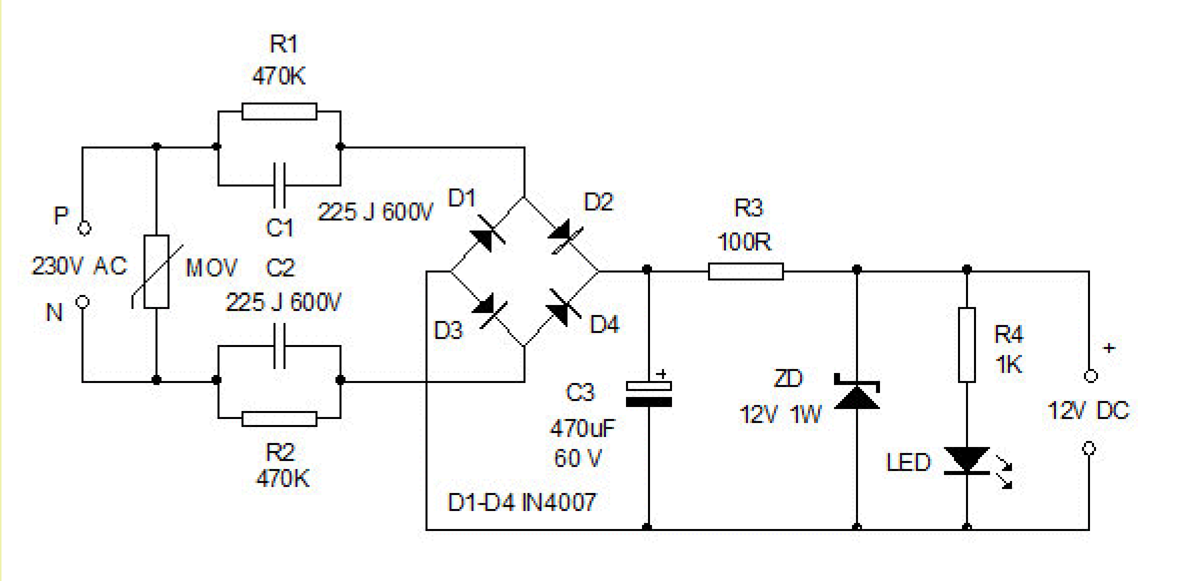
At least you are being shown how NOT to design a circuit. And this is a most-valuable lesson.

Here's another faulty circuit from Professor D.Mohan Kumar:

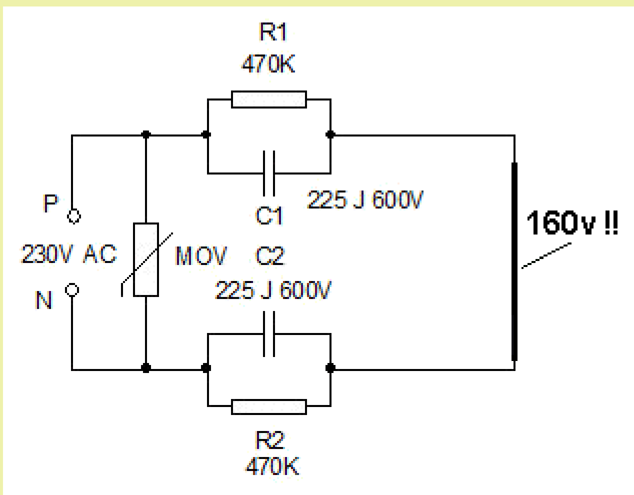


The first stage is badly designed.
A piezo element is called a HIGH IMPEDANCE DEVICE. It can produce a voltage when it is hit or bumped but the current is very small.
The load resistance on the first stage is 1k. This is classified as a LOW VALUE.
A transistor merely amplifies the current it receives via the base and allows about 100 times more current to flow in the collector-emitter circuit.
To produce a voltage-drop across the 1k resistor of 1v, 1mA must flow. The base must receive 10uA. And the voltage from the piezo element must be greater than 600mV.
A piezo element produces about 20mV to 50mV when it detects sound. A heavy strike may produce a few hundred mV. But this circuit is very unreliable.
The author has then amplified the signal produced by the first stage.
Instead of making the first stage very insensitive, he could make it more sensitive and this would require only one stage.
See "Knock Knock Doorbell" for the correct way to design a piezo-detection stage.
The biasing components for the second stage are all incorrect.
The 10k pot is in the wrong place.
Sensitivity adjustment is normally placed as the collector load. It should be 100k.
The 4M7 is too high. It should be 1M.
Diode D1 is not needed. It serves NO purpose.
In fact it should not be used. It puts a high-impedance on the input of the IC when at rest and this will allow noise to enter the chip.
It's just a badly-designed circuit.
This type of design shows a complete lack of understanding of electronics.

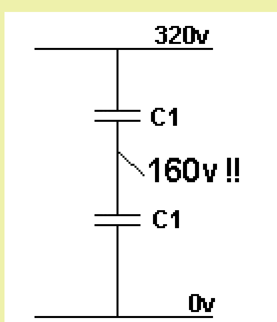
Here's an absolute DISASTER from Professor D.Mohan Kumar:



This is the most dangerous power supply I have ever seen.
The two capacitors on the front end produce a voltage-divider. To see what I mean, remove all the power supply components, including the bridge, and connect the two 220n capacitors together as shown in the following diagram:



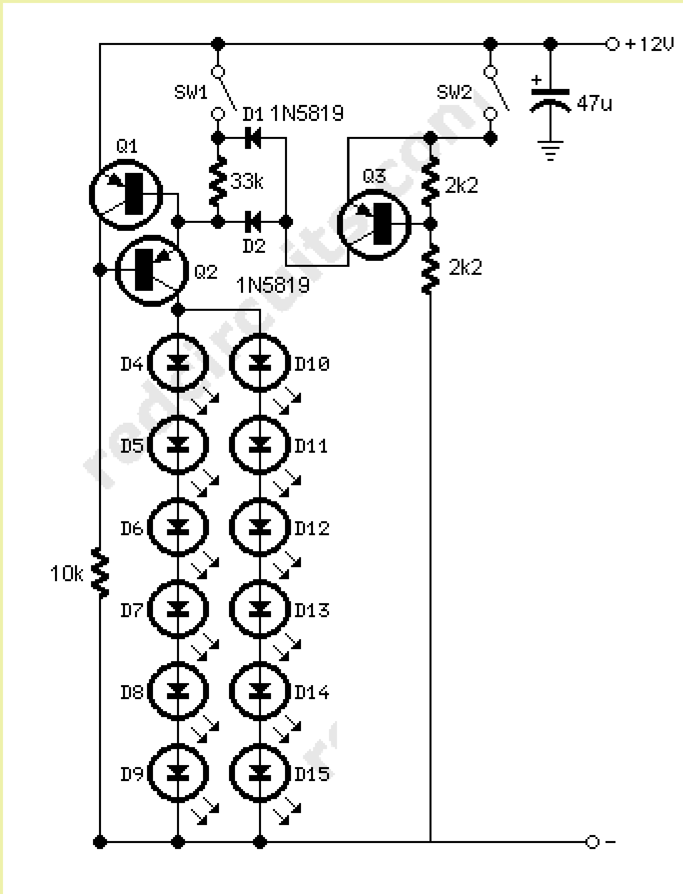
The peak voltage of a 230v AC supply is about 320v. Two equal capacitors will produce a voltage equal to half the peak value, at their join, as shown in the following diagram:



This means the capacitor-fed power supply will always be 160v higher than the neutral - no matter which way the power supply is connected.
A normal capacitor-fed power supply has one side connected to the neutral and the output is classified as "ground-referenced." This means the capacitor power supply can be touched (although it is not recommended as the input connections may be around the wrong way and the supply is really 340v above "earth").
However the supply shown above is always "180v HOT" - no matter which way the supply is connected.

Professor D.Mohan Kumar thought he was producing a safer supply.
This is what he says in his introduction:
It is totally isolated from mains supply using two capacitors in the **phase** and **neutral lines**. So the connected device is safe even if the phase and neutral lines changes.
We know how wrong he is!!! - that's why a little knowledge is DANGEROUS THING.

Here's a circuit from **RED CIRCUITS**. It is a set of LEDs with a constant current section made up of Q1 and Q2.
When Sw2 is closed, Q3 increases the current to the LEDs



There are a number of faults with this circuit.
The 33k in the constant current section will allow only a very small current to flow. The resistor should be 33R for 20mA. This gives 10mA for each string of LEDs.
The two diodes are not needed.
D2 should be replaced with a 10R resistor to increase the current though the LEDs when Sw2 is pressed. The voltage between emitter-collector of Q3 will be about 0.2v and the voltage across the 10R resistor will produce about 25mA for each string.
See The Transistor Amplifier for more details on **Constant Current**.

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SPOT
THE MISTAKES!
Page 13

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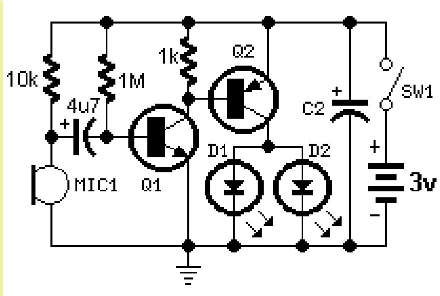
We start another page of faults, hints and corrections to circuits found on the internet.
This time we study the circuits found on RED CIRCUITS website.
This website is owned by Flavio Dellepiane.
To see all his circuits: http://www.redcircuits.com/Page1.htm to http://www.redcircuits.com/Page166.htm simply increment the page number from 1 to 165.
When asked to explain some of the following faults, he just said "Goodbye."
He has since replied again by email but failed to explain any of the mistakes below. He did, however, say he was an amateur and I am not sure if he designed any of the circuits himself, but he did say he included component values on the diagrams he uses himself.
It is a pity he did not continue this trend when presenting the diagrams on the web, as this would have made my investigation much easier.

I know it's embarrassing to be shown-up, but the only way to strengthen the web is to weed out the faults and scams.
A lot of the scams have been exposed and the links have been closed, and yet the magnetic motor, based on Tesla's concepts, still fills my email in-box. See: Tesla's Secrets.
Scams on eBay have however been eliminated and this has made purchasing things in the web totally reliable.

Now to **Red Circuits**.
Many of Flavio's circuits contain extra components that have no function.
One of the points I have made in the past is to remove each component and see if it alters the operation of the circuit.
Next, increase and decrease the value to see if it has any effect.
This serves two purposes. It lets you know if the value is critical and if it is needed. Some circuits are so badly designed that they stop working when the rail voltage drops a small amount. Others fail to work if one or more components are substituted.
But adding extra components is a mystery. I cannot work out why the designer added the parts. Maybe he added them when designing the circuit and failed to remove them at the end.
Let's see . . .

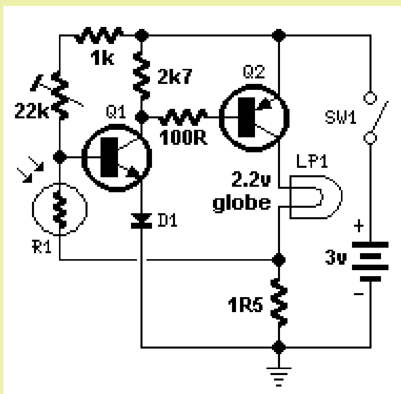
You can instantly see that Flavio is not an electronics engineer. He lists the components on the circuit as R1, R2 etc and provides a list.
A circuit without component values is totally useless.
An electronics engineer can "see" the circuit working when component values are included. It's a bit like showing a photo with the faces "painted-out" and placed below the photo.
I have absolutely no idea what his circuits are doing until I fill in the component values.

Halloween Flashing-eyes Badge



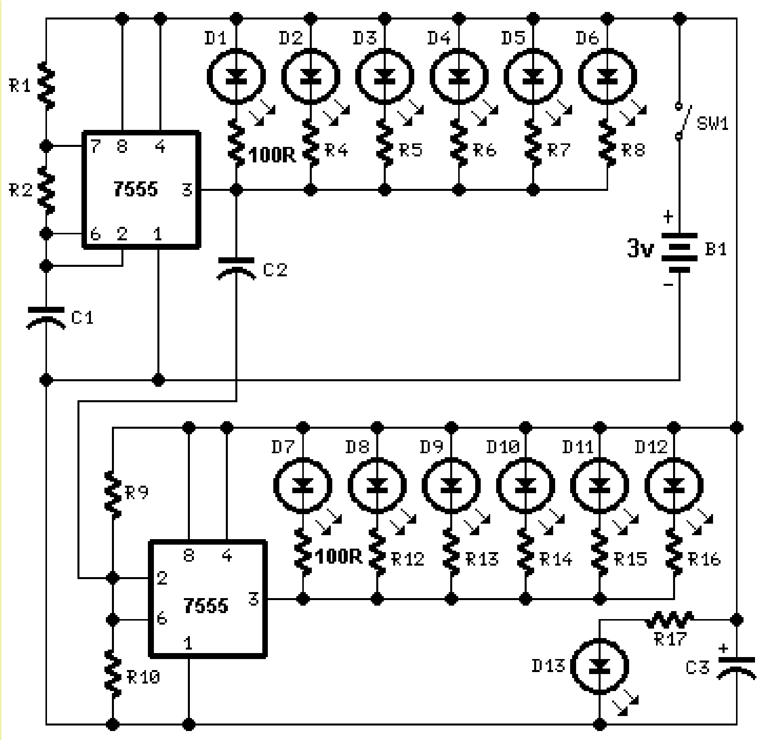
Two faults with this circuit.
The current-path though the two transistors consists of junction-drops. The path is as follows: Emitter-base of Q2 then collector-emitter of Q1. The first junction-drop is 0.7v. The second drop is normally 0.2v. The supply is 3v. There is no resistor to take up the excess voltage.
What happens is this: Q1 does not turn on fully and the voltage across collector-emitter is 2.3v. Since Q1 is turned on very lightly, the collector-emitter current will be less than 1mA.
Q2 will amplify this current 100 times and the current through the LEDs could be as high as 50mA each.
There is no current-limiting for the LEDs.

Bike Light-1



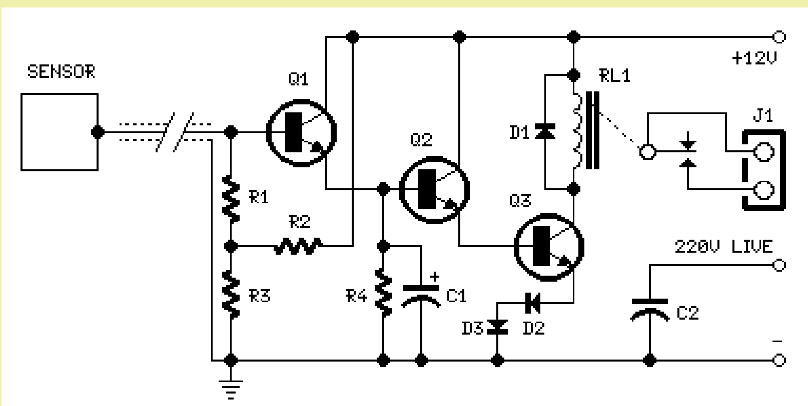
What is the purpose of D1? Remove it and see if the circuit still works. It will change the setting of the LDR (R1) but the circuit will work when it is removed.

Bike Light-2



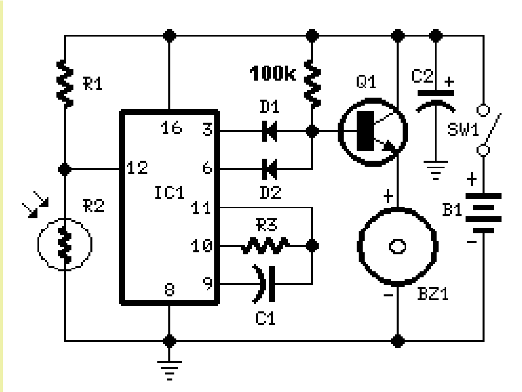
The main fault with this circuit is the driving-power of the CMOS 7555 IC. It will only sink 30mA when the supply is 3v.
This gives about 5mA for each LED.
The circuit should have a driver transistor on each output.
Bike Light-2 is quite useless.

Capacitive Sensor

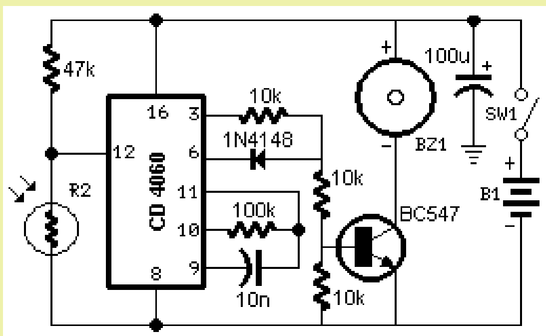


The purpose of D2 and D3 is unknown. They are not needed.

Fridge Alarm

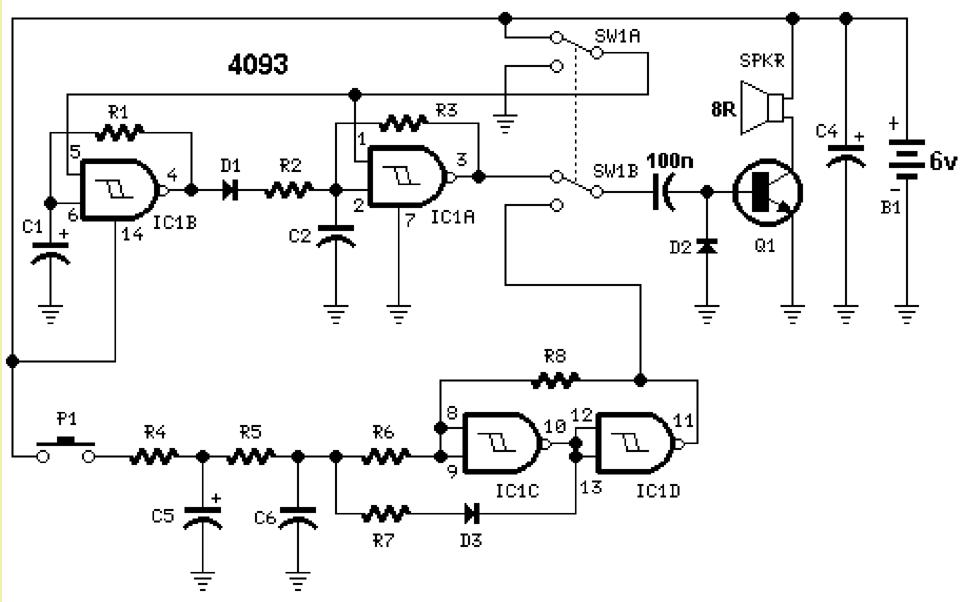


This circuit is badly designed. The two diodes pull the 100k down and this takes a small amount of current when the alarm is not being used.
By re-arranging the parts, the circuit will not take any current in this section.



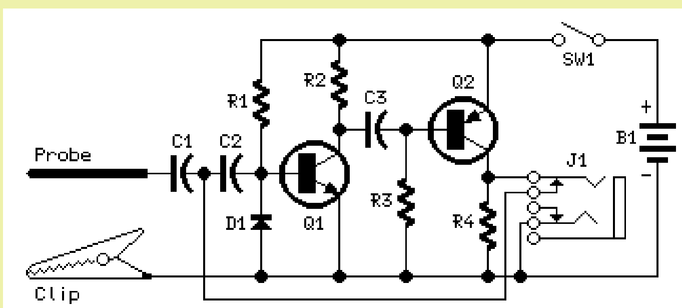
Note: The first circuit has an AND gate made up of the two diodes and 100k resistor. The lower circuit has an AND gate made up of a 10k resistor and diode. The two resistors connected to the base produce a voltage divider so the base sees only about 0.35v in the LOW state. It is turned by the top 10k and when pin 6 is HIGH, the diode does not remove (or "short" or "deck") the "turn-on voltage" from the chip.
Pin 3 is the highest division for this chip (it divides the clock by 16,384. This is 128 x 138) and the timing components on pins 9 and 10 allow pin 3 to go HIGH after about 20 seconds.
Pin 6 has a lower division (it divides the clock by 128) and it goes HIGH/LOW 128 times before pin 3 goes HIGH. But nothing happens during this first 128 outputs as pin 3 is not HIGH.
The circuit requires pin 3 to go HIGH to pull the base of the transistor HIGH and turn on the piezo buzzer. But this only happens when pin 6 goes HIGH and the result is a beep from the buzzer. Pin 6 goes HIGH/LOW 128 times during the next 20 seconds and this makes the buzzer create a "beep-beep-beep" sound.

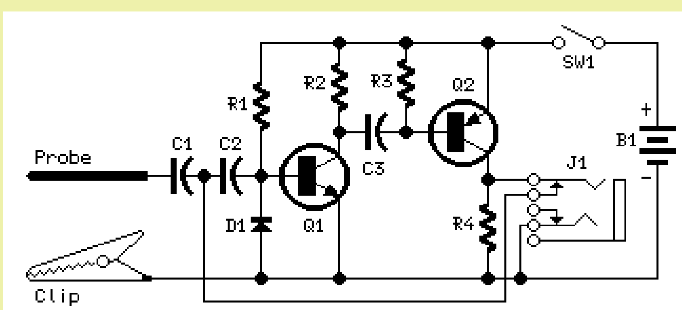
Police Siren



The only problem with this circuit is the 100n driving the base of the output transistor.
A 100n will not provide the energy-transfer needed from the output of the chip to the base of the transistor.
The 100n will only supply short pulses of waveform and the output signal will be very weak and not of the required shape.
The 100n should be replaced with 220R to 470R.

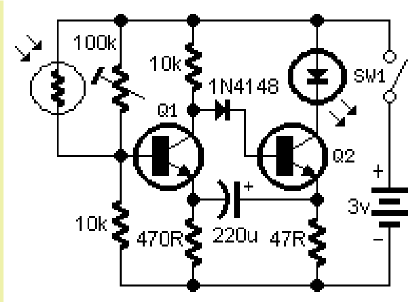
Signal Tracer:





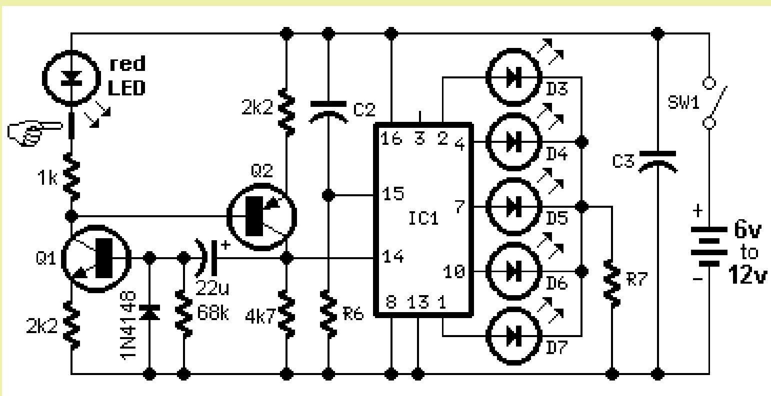
The only fault with the circuit is the placement of R3. It should be connected between base and positive rail so the output transistor is not taking any current when the circuit is switched on.
When a signal is detected, the first transistor will activate t he second transistor via C3.

LED Flasher

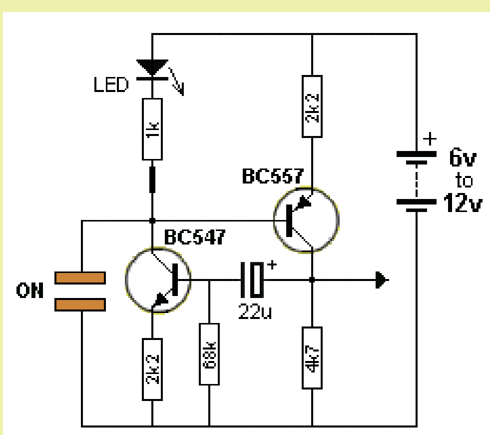


Here is a circuit that does not work.
Maybe it worked for Flavio. But it doesn't work for me. I tried changing the value of the 100k pot and altered the supply voltage. But it never made a flash.
This circuit reminds me of some very early multivibrator circuits. The resistance values had to be accurately selected and when the battery voltage reduced, the flasher stopped working!
A circuit must work the first time it is assembled and the parts must not be critical. Especially when we have reliable flasher circuits that work from 3v to 9v and down to 2v.

Touch Switch

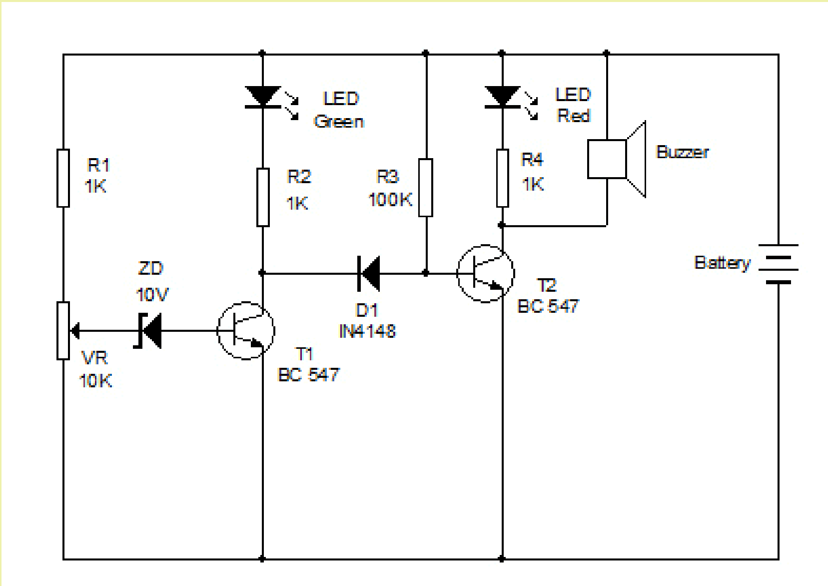


This clever circuit has one problem. It is not reliable. The operator must have static or mains hum on his/her finger to activate the circuit.
It may work the first time due to static build-up on the operators finger but if this charge is not present, the circuit will not activate.
The solution is to provide two touch pads to create a "turn-ON' circuit as shown in the diagram below:
One advantage of this circuit is the current drops to zero when not activated as both transistors are turned off.



Here's another disastrous design by D.Mohan Kumar
The circuit has NOT been tested as it DOES NOT WORK.

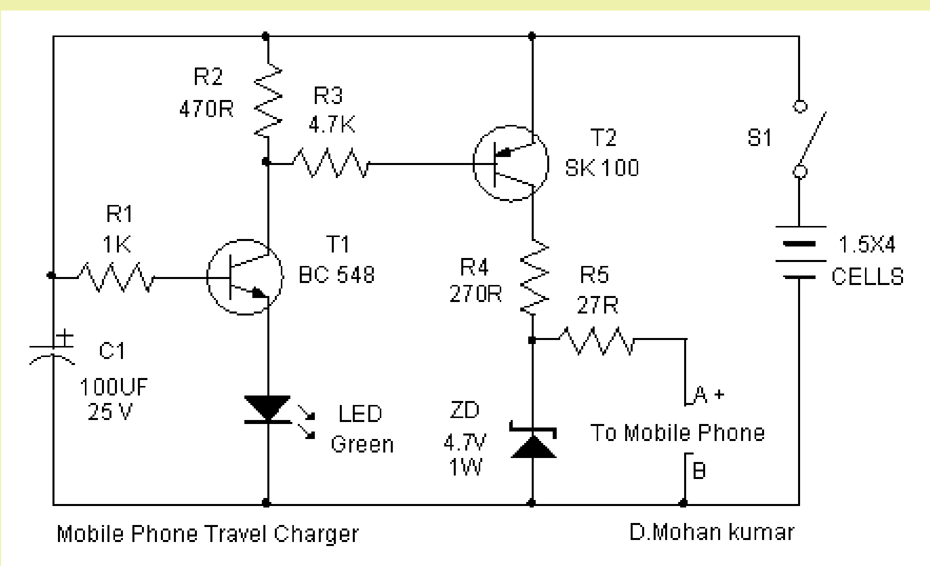
He is supposed to be a University Lecturer in India. He designed a similar faulty circuit and we covered it on Page 12. He never tests anything.



11.5v BATTERY MONITOR

Transistor T2 will never turn off. It is being turned ON by R3. The circuit is trying to turn it off via T1 and D1. But the voltage drops across T1 is 0.2v and 0.7v across D1. This produces a voltage drop of 0.9v
T2 requires a voltage drop of less than 0.7v to turn it OFF. It will NEVER turn OFF.
All his circuits are faulty. Why doesn't **D. Mohan Kumar** test his circuits before putting them on the web? Simply remove D1 and the circuit will work.

Here's another disastrous design by D.Mohan Kumar
The circuit has NOT been tested as it DOES NOT WORK in the way it has been described.



Here is his wording and my corrections:

Here is an ideal **Mobile charger** using **1.5 volt pen cells** to charge mobile phones while travelling. It can replenish cell phone battery three or four times in places where **AC power** is not available.
Most of the Mobile phone batteries are rated at **3.6 V/500 mA.** They are rated as 3.6v / 500mA-Hr.

A single pen torch cell can provide **1.5 volts and 1.5 Amps** current. Penlite cells (or any dry cells) are not rated as maximum current capability. They are rated in capacity (amp-hours or

mAHr) and a penlight cell has about 1 amp-hour when discharged at about 10mA.

So if four pen cells are connected serially, it will form a battery pack with **6 volt** and **1.5 Amps** current. This should be: 6v and 4 amp-hours. This is equal to 6wattHrs

When power is applied to the circuit through S1, transistor T1 conducts and Green LED lights. When T1 conducts T2 also conducts since its base becomes negative. Charging current flows from the collector of T1.
To reduce the charging voltage to 4.7 volts, Zener diode ZD is used. I have no idea what he is talking about????

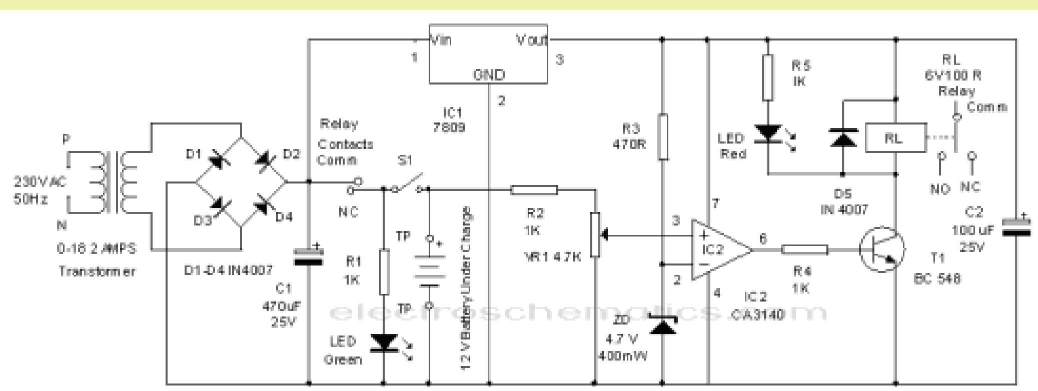
Resistor R4,and R5 allows 20 mA charging current. This is NOT true. Battery voltage = 6v. Voltage emitter-collector of transistor = 0.3v. Battery voltage rises to more than 3.6v during charging, but say it is 3.6v. Voltage across 270R + 27R = 2.1v Current = 7mA.

If more current is required, reduce the value of R4 to 100 Ohms so that with in 20 to 30 minutes battery will become fully charged. This is NOT true. Current through 100R + 27R = 16mA. Battery capacity is 500mA-Hr Time to charge = 500 / 16 = 31 hours !!!!!!

D. Mohan Kumar is a University Professor. How can he get calculations so wrong??????
How can he design such a useless circuit?

What is the circuit supposed to do? It does not turn off when the phone battery is charged. The zener diode simply takes over and wastes energy until the 4 penlite cells are flat.
No-one sells SK100 transistors. Use BC 557 or BC327
What is the function of the 27R resistor? It is not needed.
What is the function of the 100u. An electrolytic across the power supply is only needed when the circuit contains AC signals.
What is the function of T1? It is not needed.
What is the function of T2? It is not needed.
As you can see, the circuit is an absolute DISASTER.

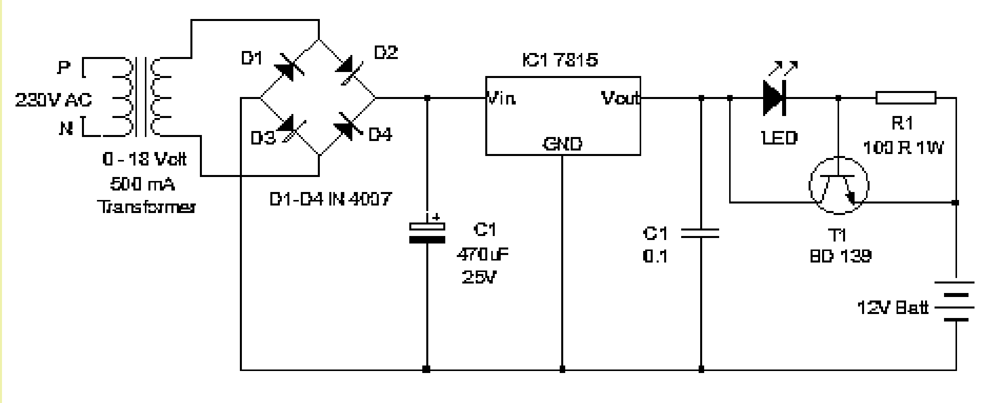
Another D.Mohan Kumar disaster:



Don't worry if you can't see all the component values. DO NOT BUILD THIS CIRCUIT. It is a DISASTER.

This is the worst battery charger circuit I have seen.
The transformer is 18v RMS and this will convert to at least 22v after rectification.
The battery voltage is about 14v when charging and this means the difference in voltage is 8v.
There is no dropper resistor to drop the 8v and this means the transformer will deliver more than 2 amp and it will burn out in less than an hour.
You simply cannot connect a transformer to a battery without some form of current-limiting. On top of this, the 1N4007 diodes are 1 amp and they will burn out in about 10 minutes.
Why is it that **D. Mohan Kumar** keeps presenting circuits he has not tested?
What is wrong with the Professor????
Why do professors wear slip-on shoes? Because they haven't learnt to tie shoe-laces.
"Professor, you have one black shoe and one brown shoe"
"That's funny, I noticed another pair just like this in the cupboard."

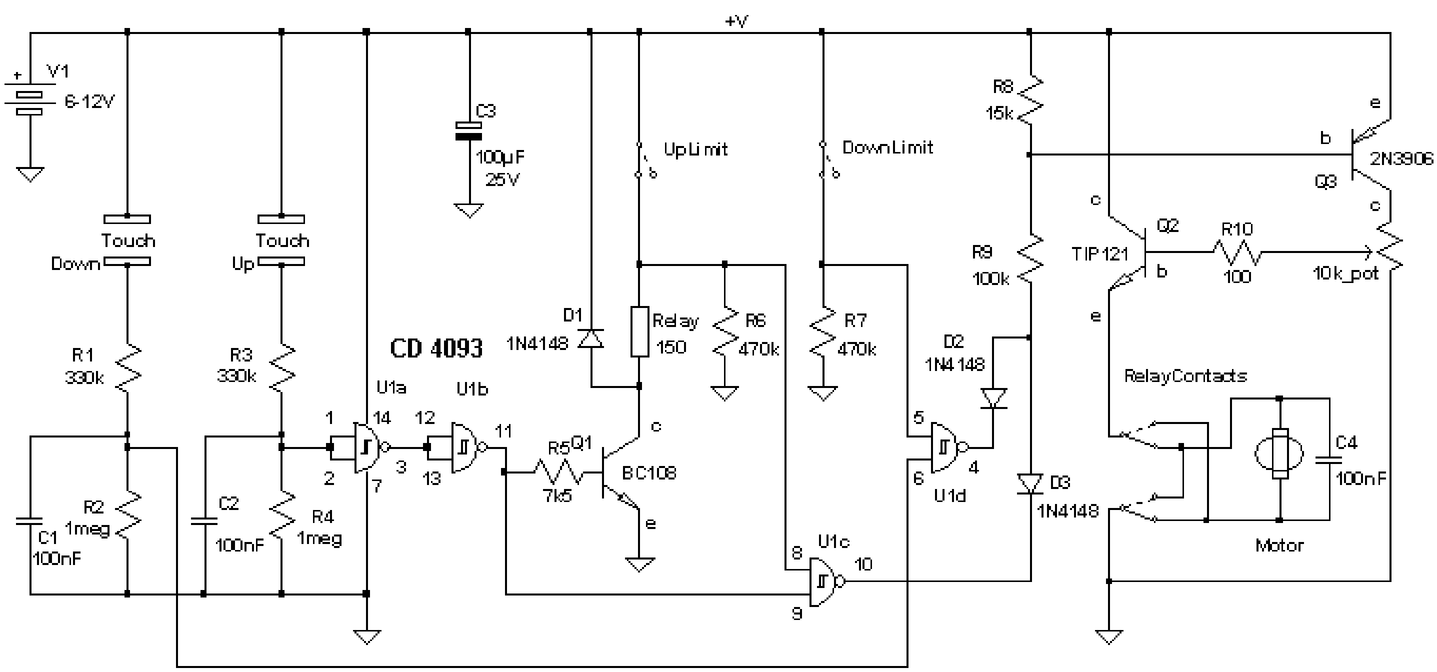
Another untested D.Mohan Kumar circuit:



The 15v regulator will NEVER charge a 12v battery. 1.7v is dropped across the LED and 0.7v between the base and emitter. This leaves 12.6v
The battery voltage rises to over 14v during the charging process and you need a voltage higher than this to create a current-flow.
What is the purpose of the 15v regulator?
This is another disaster by **D. Mohan Kumar.**

I am waiting for **D. Mohan Kumar** to write up another "disaster." You can learn more from a faulty circuit than a circuit that works! I have learnt more from **D. Mohan Kumar** than anyone else. I can see his incorrect reasoning and many other beginners will have the same faulty reasoning.
This is something text-books should have done 50 years ago. They should "pull you up" and prevent faulty reasoning.
It is not good enough to provide only the correct reasoning because a beginner may think there is also an alternate approach and the faulty concepts are not addressed.

This circuit has 3 minor faults that need addressing:



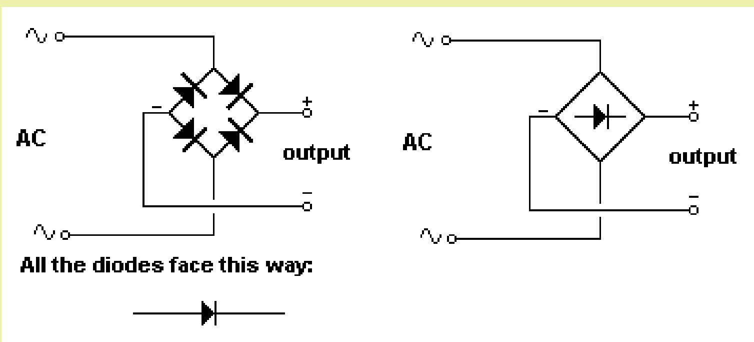
The TOUCH PADS work on a voltage-dividing arrangement. The voltage on the input (made up of inputs 1&2) needs to be higher than 66% of rail voltage for the gate to see a HIGH. (This is because the chip is a Schmitt Trigger and it works on 1/3 2/3 detection).
The resistance of a finger can be about 100k. This gives the input as 430k:1M or 70% of rail voltage. This is very close to 66% and the touch switch may not work every time. The 330k needs to be reduced to 47k to produce reliable triggering.
The resistance of R9 puts a voltage of 0.65v on the base of Q3 when using 6v.
This is barely sufficient to turn the transistor ON. Use 10k for a reliable operation.

When R9 is 10k, D2 can be removed and D3 replaced with 10k.
I would make R8 = 47k to signify it is just a value to keep Q3 turned off.
The TIP121 is a Darlington transistor and it is used in an emitter-flowerer arrangement with the 10k pot.
Adjusting the pot will reduce the speed of the motor.
This creates a big problem. Many times a motor will not start when the speed is reduced. The circuit should be designed with PWM using the 4093 chip and a few extra components. This will reduce the heat dissipated by the TIP transistor and guarantee reliable start-up.

Drawing Circuits

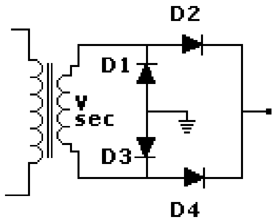
Always draw a circuit so it is easy to read. This includes simplifying a circuit and making sure the project works by assembling the components and testing it with slightly different values to make sure you have selected the best values.
In this "Mistake" we have selected a simple component: A BRIDGE RECTIFIER and shown how it can be drawn incorrectly.

A BRIDGE RECTIFIER should be drawn with 4 diodes POINTING IN THE SAME DIRECTION. This makes it easy to see it is a rectifier and you don't have to work out what it is doing.
The following diagram shows a bridge rectifier with 4 individual diode symbols and a bridge symbol with a single diode to indicate the direction of the 4 diodes.

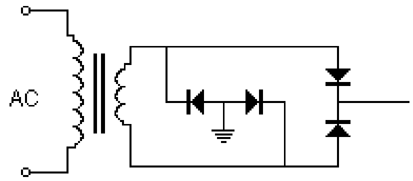


The following diagrams are hard to read and three are drawn incorrectly:

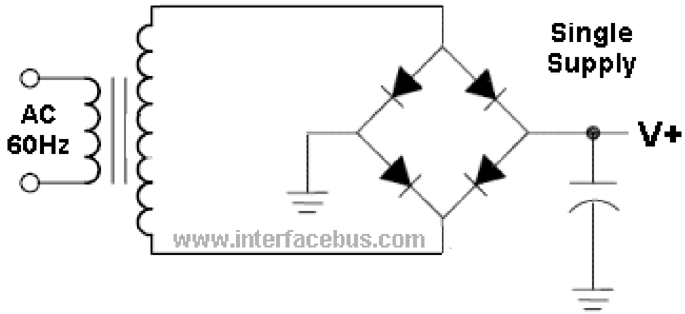
This bridge is hard to follow:



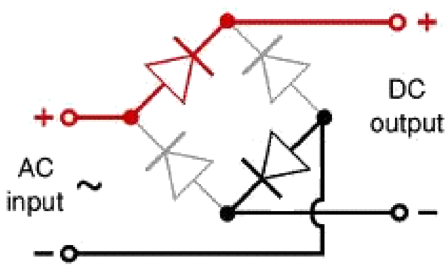
This bridge is hard to follow:



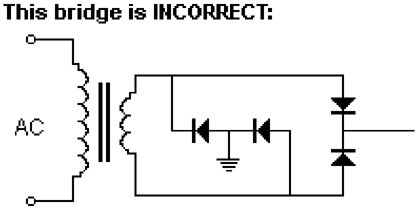
This bridge is INCORRECT:



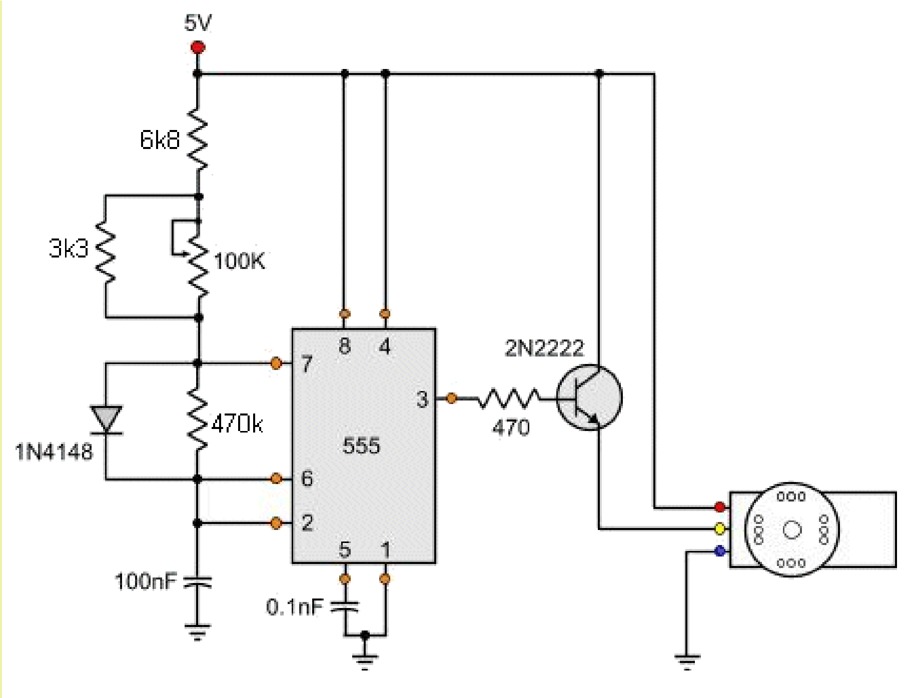
This bridge is INCORRECT:



This bridge is INCORRECT:

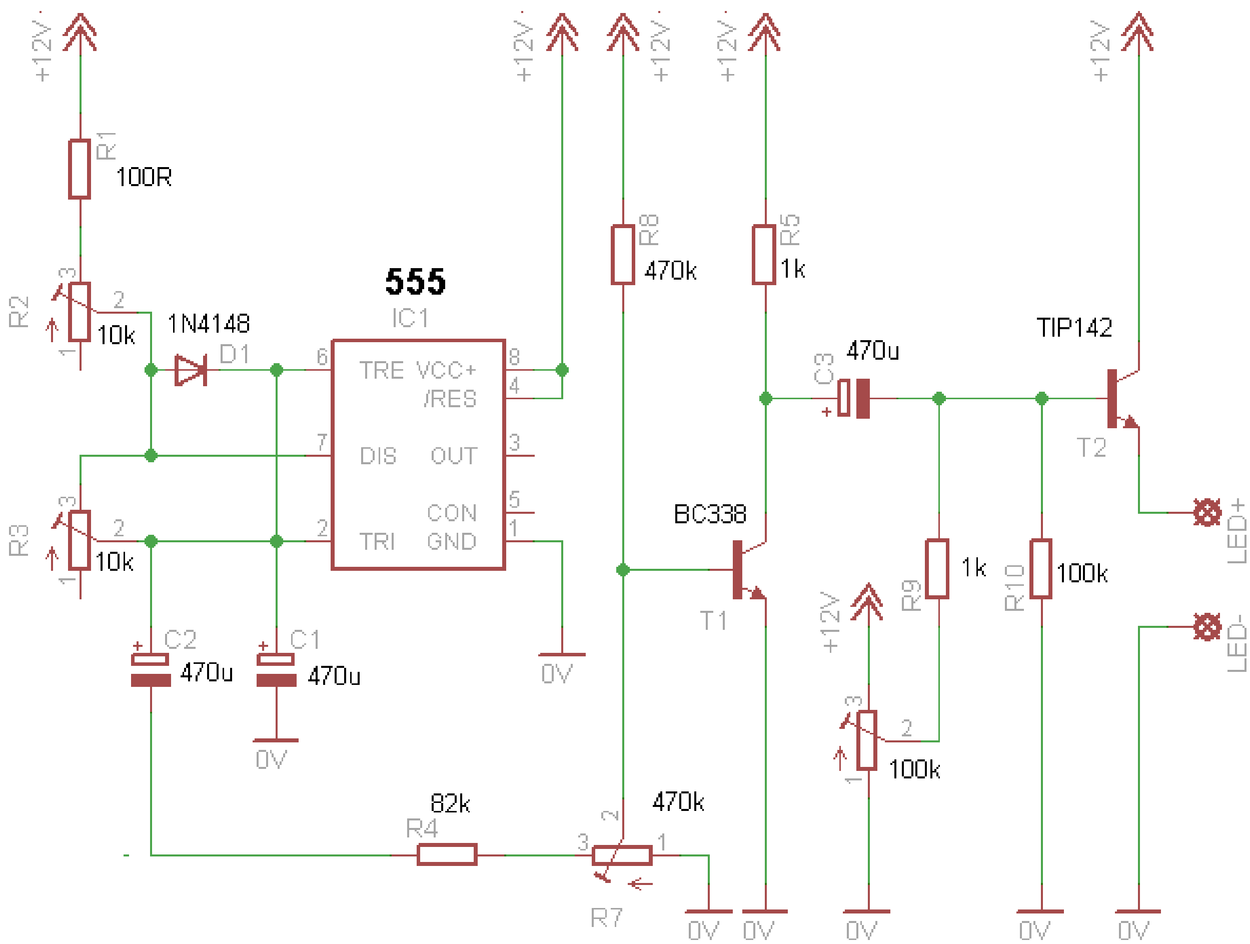


Here's a circuit that shows the designer has no idea what he is designing:



The yellow signal wire to a servo does not require any current. It is purely a signal line and requires a fairly high amplitude. The 2N2222 buffer transistor is not assisting in any way AT ALL. It is reducing the amplitude of the signal by about 0.5v and the signal does not have to be buffered.
It can be connected directly to pin 3 of the 555.

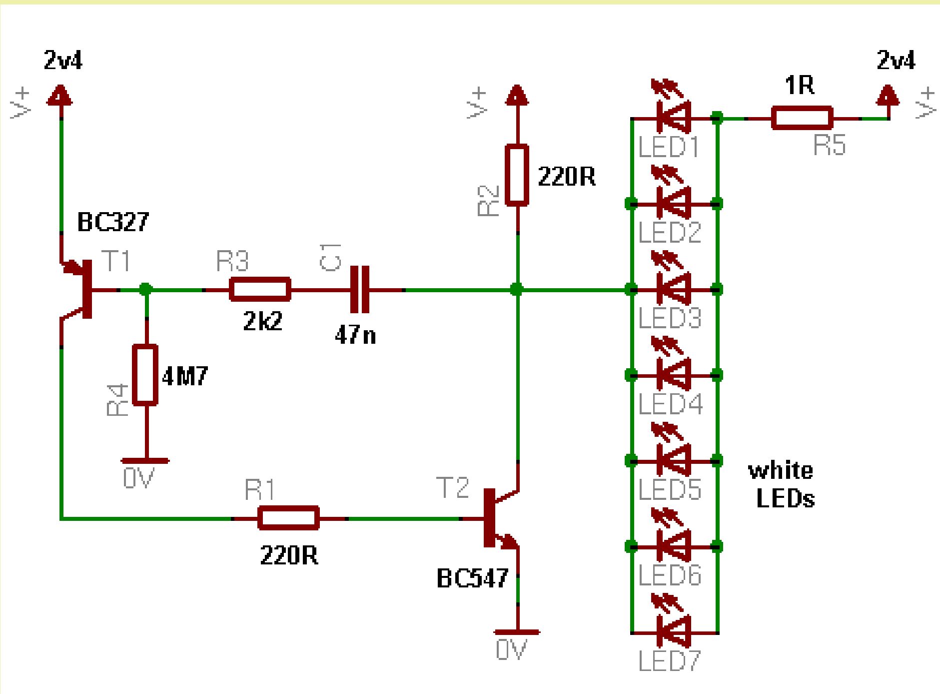
Here's an over-designed circuit:



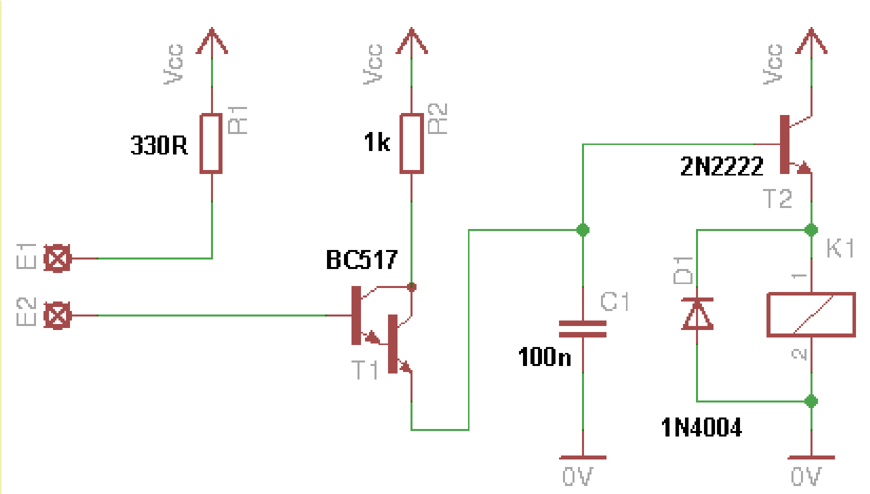
The value of R1 is too low. If R2 is turned fully, pin7 will allow about 100mA to flow through the pot and it

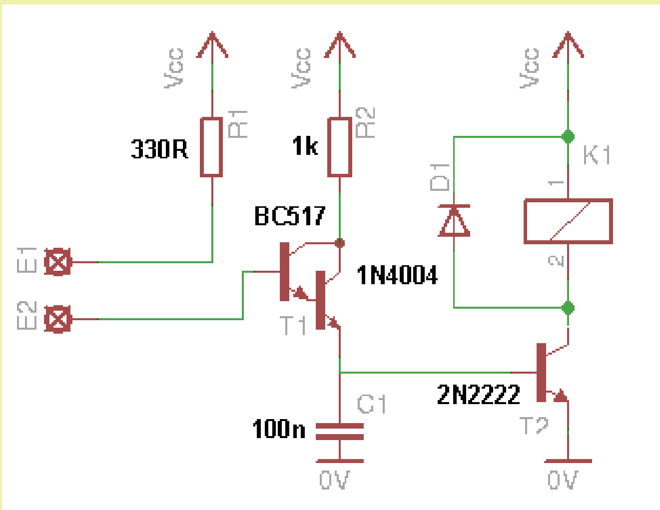
will be damaged. R1 should be more than 1k.
C1 should be reduced to 47u and R2 and R3 increased to 100k. This will gave the same timing with an easy-to-get 47u.
R4 is not needed.
The BC338 transistor can be a BC547 device to show a high current transistor is not needed.
R10 is not needed.
TIP142 should be drawn as a Darlington transistor.
R9 is not going to provide any protection for the LEDs because the Darlington transistor requires very little base current and if the 100k pot is turned fully the LEDs will see nearly 11v.
The circuit is very dangerous and should be adjusted very carefully.

Here we have another poorly designed circuit by Mr **Giorgos Lazaridis** of PCB Heaven:
He tried the circuit with white LEDs and used two 1.2v cells. This gives a supply of 2.4v.
The problem is: White LEDs require 3.2v to 3.5v for correct illumination. Some white LEDs will operate on a lower voltage but the brightness will be very low.
The second fault in the circuit is the 1R resistor. This is the current-limit resistor and prevents excess current flowing through the LEDs.
When the supply is increased, this resistor will need to be increased.
Refer to our article in **30 LED Projects** for an explanation on how to determine the value for this resistor.
The BC327 is a fairly high-current transistor and using this type infers that a high current will be flowing in this particular part of the circuit. This is not so and the transistor should be given as BC557.
However the BC547 transistor needs to be a fairly high-current device and should be stated as BC337.
The circuit should be supplied via 4v5 (three cells) and R5 should be 8R2 or 10R.

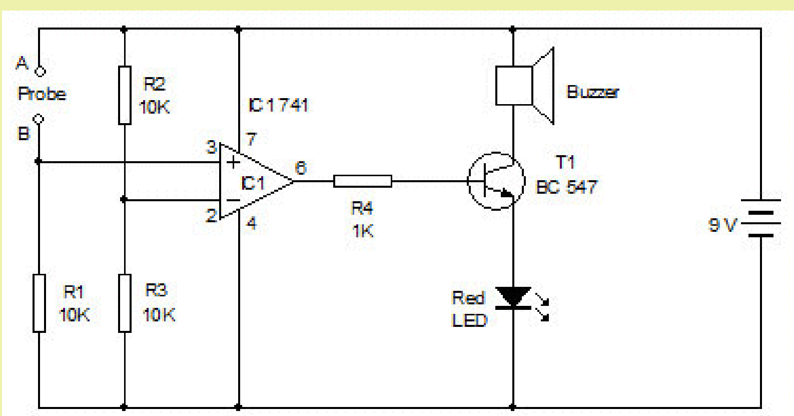


An emitter-follower design is very bad as you are losing over 2v in the base-emitter junctions. This means the supply should be 2v higher than the voltage of the relay for guaranteed operation and the final transistor has about 1.5v between collector and emitter. This will add to the losses and heat up the transistor slightly more than a common-emitter design. The second circuit shows the improved design.



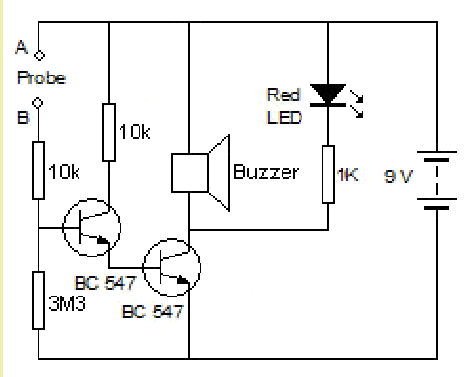


Here's another circuit from [D.Mohan Kumar](#):
The circuit is badly designed as the LED will only allow 20mA and we don't now the current requirement of the buzzer. But the main issue is the over-design of the circuit. The same result can be achieved with fewer components, less cost and it will consume NO CURRENT when sitting around.
It gives an audio visual indication when the water level rises towards the top of the tank so the water pump can be switched off to prevent overflow. Probes A and B are placed at the top of the tank and when the water reaches the probes, the buzzer is activated.



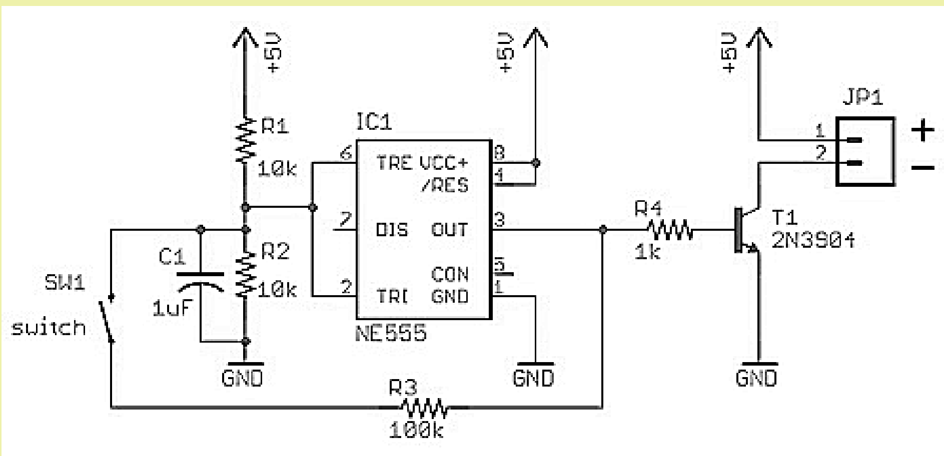
Water Level Alarm

Here is the improved circuit:



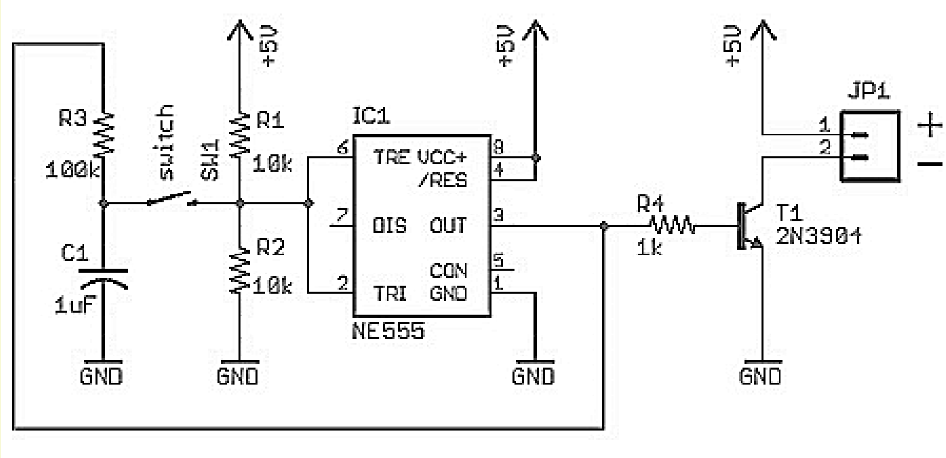
Water Level Alarm

Here is a toggle circuit that does not work. Pin 2 detects less than 33% of rail voltage and pin 6 detects more than 66% of rail voltage.
These two pins are being held at 50% of rail voltage via the two10k resistors. The problem is this: The 100k resistor from the output of the chip will not raise or lower the two pins by the 15% needed to change the state of the circuit. If the two 10k's are changed for 100k and the 100k changed for 10k, the circuit will work.
However we have a time-delay created by the 1u and if the switch is pressed for too-long, the circuit will change back to it original state.



toggle switch with momentary button

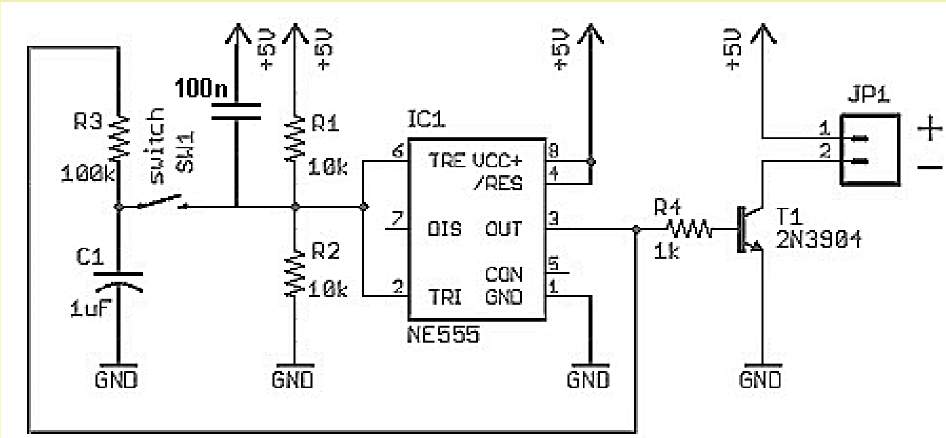
An improved design places the switch as shown below: The 1u is now charged to about rail voltage or about 0v via the action of the output of the chip and this voltage is immediately delivered to pins 2&6 via the switch. If the switch is kept pressed, the ratio of the resistors will not cause the chip to change states, as discussed above.
Simply changing the position of the switch turned a faulty circuit into a success.



toggle switch with momentary button

One further problem with the 555 is this: Pin 3 does not go below about 0.6v and the 2N3904 transistor does not fully turn off.
Fit a 2k2 between the base and 0v to reduce the voltage on the base to fix this problem.

Some readers have asked for the circuit to turn-on in RESET mode.
Pin2 detects a LOW to make the output HIGH. If a 100n capacitor is placed across the upper 10k, the 555 will turn on in RESET mode.



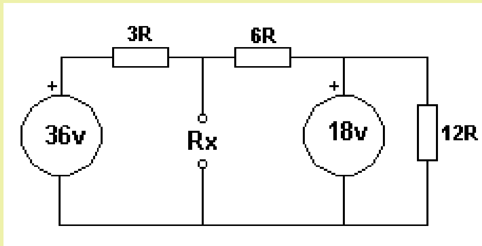
toggle switch with momentary button
TURN-ON IN RESET MODE

Here's an example of "clear thinking."
In other words, look at the problem and see if it can be solved very simply.
Here is the answer from a reader with "mathematical understanding."
Using the node method, find the voltage across Rx in terms of Rx.
Use E^2/Rx and find the term for power across Rx in terms of Rx
Find the first derivative of the power with respect to Rx and solve for its zero value.
When Rx = 18 ohms, the maximum power is obtained.
The above reasoning is entirely WRONG.

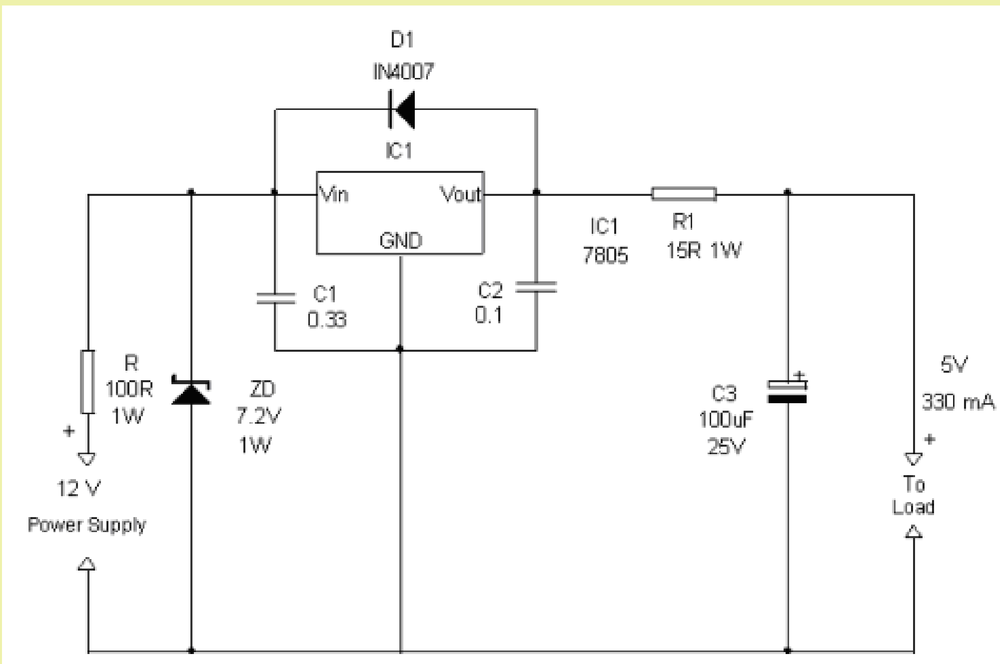
The circuit is very complex until you realise one thing.
Firstly, remove the 6R, 18v and 12R.
Maximum power in Rx is achieved when Rx is equal to 3R.
To see if this is true, simply change Rx to 2R or 4R and work out the watts dissipated.
Another way to look at it is this: When Rx is zero, the watts dissipated is zero, when Rx is very high, the watts dissipated is very small.

Make Rx = 3R and see what happens:
The voltage across Rx will be 18v.
Now put-back the 6R, 18v supply and 12R load resistor.

The voltage across Rx is 18v. This means no current will flow though the 6R resistor because it has 18v on each end.
Current through Rx = 36v/6R = 6 amp
Wattage dissipated by 3R = $V^2/3$ = 108watts or I^2xR = 6^2 x 3 = 108watts
We have turned a seemingly complex question into a very simple answer.

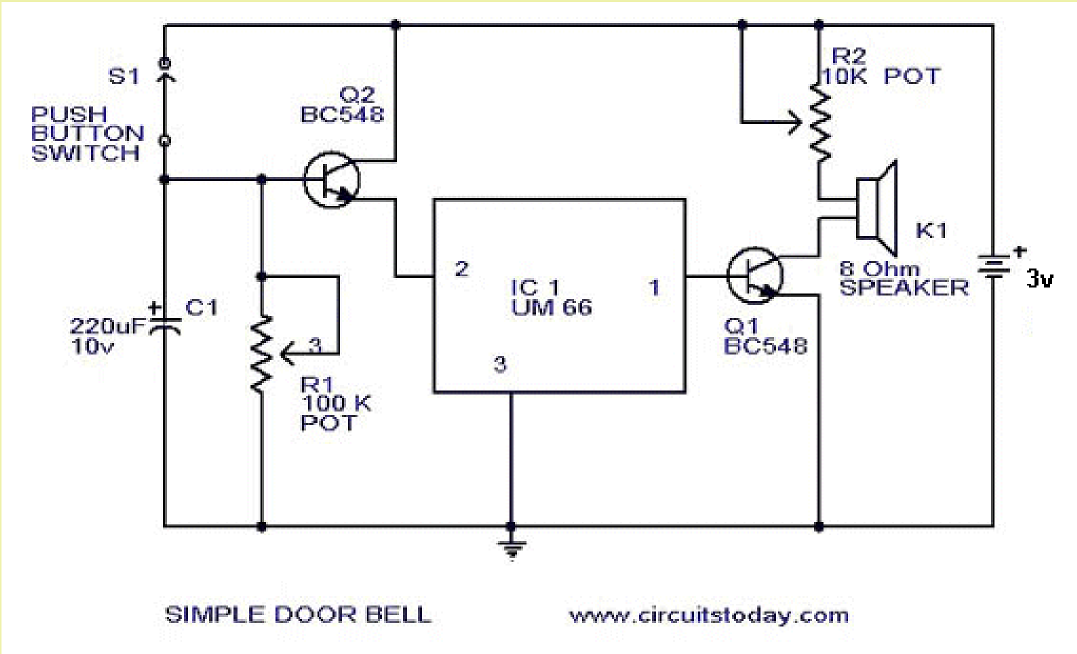


Here's another disastrous circuit from D.Mohan Kumar:

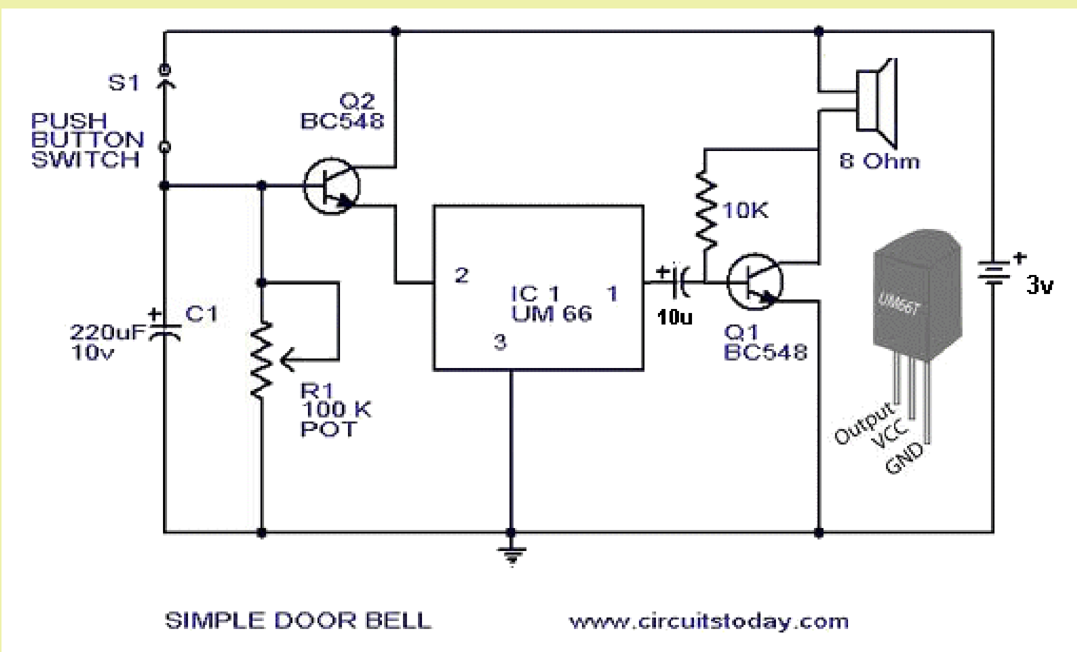


The 100R resistor on the input has 12v - 7.2v = 4.8v across it and 48mA will flow through the resistor and 7.2v zener.
Suppose the power supply delivers 20mA to a load. The 7805 takes 10mA, making a total of 48+20+10 = 78mA
The voltage across the 100R will increase to: V = 0.078 x 100 = 7.8v The input voltage will be: 12v - 7.8v = 4.2v The power supply cannot even deliver 20mA!!!!!!!!
This is another of Professor D.Mohan Kumar's disasters. He should stop putting rubbish like this on the web. He doesn't know a thing about electronics.

Here's a circuit from D.Mohan Kumar and other Indian websites, that does not work. They copy each other and never build the circuit. They obviously think "it'll work" because I am a Professor!



The output of the UM66 is not sufficient to turn on the transistor. It may work for some transistors and it may work when the load is very high. But it doesn't work for the circuit above.
The solution is to self-bias the output transistor and couple it to the chip with a capacitor.
Always build EVERY circuit before putting it on the web. You never know what fault will come out of even the simplest circuit.
The UM66 series of chips have a range of tunes. The UM66T19L outputs "For Elise." The other chips are listed below. When ordering, make sure you ask for the exact song you require.

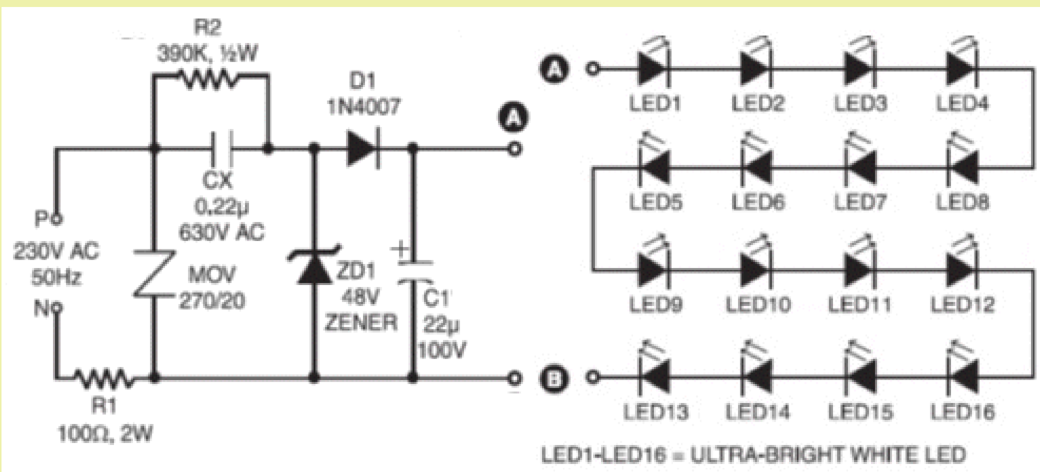


Here is the list of different chips and their content:

Song Series List

Part No.	Song Name
UM66T01 L/S	Jingle Bells + Santa Claus is Coming To Town + We Wish You a Merry X'mas
UM66T02 L/S	Jingle Bells
UM66T04 L/S	Jingle Bells + Rudolph, the Red-nosed Reindeer + Joy to the World
UM66T05 L/S	Home Sweet Home
UM66T06 L/S	Let Me Call You Sweetheart
UM66T08 L/S	Happy Birthday to You
UM66T09 L/S	Wedding March (Mendelssohn)
UM66T11 L/S	Love Me Tender, Love Me True
UM66T13 L/S	Easter Parade
UM66T19 L/S	For Elise
UM66T32 L/S	Waltz
UM66T33 L/S	Mary Had a Little Lamb
UM66T34 L/S	The Train is Running Fast
UM66T68 L/S	It's a Small world

Here's a simple circuit driving 16 white LEDs from the mains.



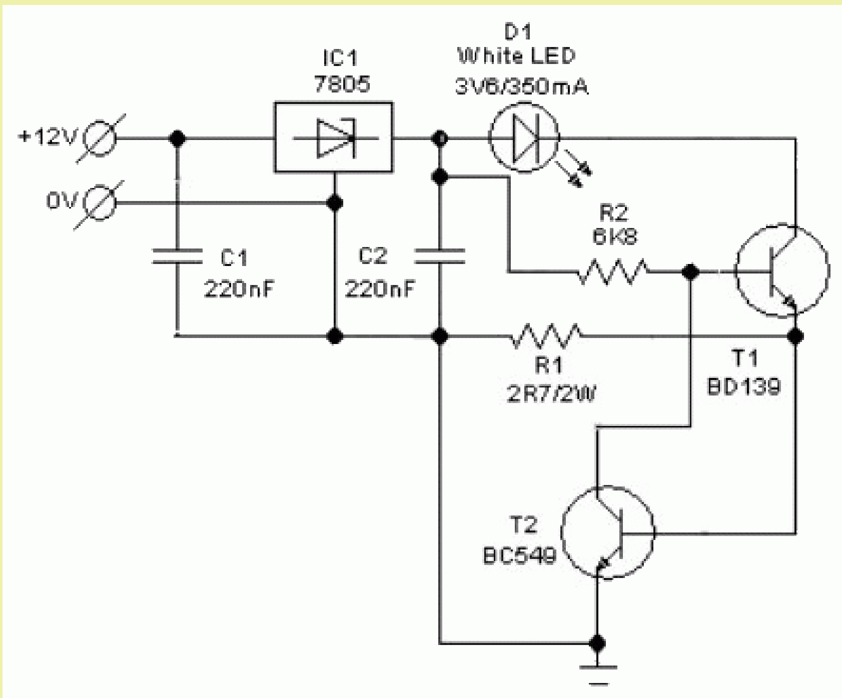
Here's three technical mistakes from a chief electronics editor:
1. He says:
"The 48V zener is there to clamp the supply to the LED chain to +48V maximum."
Not true.
If it actually did that, the LEDs would not work or be very dull. The REAL purpose of the zener is to discharge the capacitor.
2. He says:
The current through the LEDs is 25mA.
Not true. The current though the LEDs is about 7mA
3. He says:
"With the 22uF present during the negative half cycle, the 22uF supplies a lower holding current to the LED's so they do not go completely off."
See discussion below.
He also falsely thought the LEDs would flicker at 25Hz on a 50Hz supply.

The current is limited by the 0.22u capacitor and it is a capacitor-fed power supply that is commonly known as a CONSTANT CURRENT SUPPLY. In this case the current is limited to 7mA.
At 7mA the voltage across a white LED is 3.3v. At 3mA the voltage is 3v.

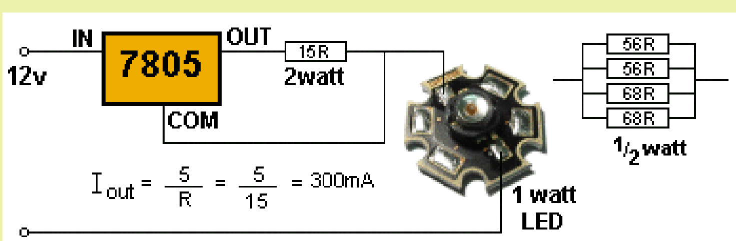
Without the electrolytic, the LEDs produce a noticeable flicker.
This is because they are being fed pulses during the positive half-cycle and turn-off completely during the negative part of the cycle.
The voltage only has to drop from 16 x 3.3 = 53v to 16 x 3 = 48v and the LEDs do not illuminate.
This means they are only illuminating during the top 10% of the voltage-curve and when this is analysed

on a width-basis, it represents about 50% ON-time.
You can observe this by setting up the circuit and shaking it from side-to-side and see when the LEDs are illuminated.
When the electrolytic is added, some of the current charges it during the peak of the waveform and as the waveform reduces, it delivers this energy to the LEDs to keep them illuminated during the dip in voltage.
The electrolytic would be much more effective if it were connected to the supply voltage with a 470R connected to the LEDs. This would allow it to be charged to a higher voltage so it can deliver its energy during the remainder of the cycle.
In fact the circuit will not work with 16 LEDs as they drop 16 x 3.3v = 53v. The zener limits the voltage to 48v and the LEDs will be very dull.
The zener should be replaced with a 1N4004 diode.
It's a very poorly designed circuit with at least 3 faults.
See: "**30 LED Circuits**" eBook for a number of correctly-designed circuits.

This circuit produces a constant 350mA to illuminate a 1 watt LED. The circuit is over-designed.



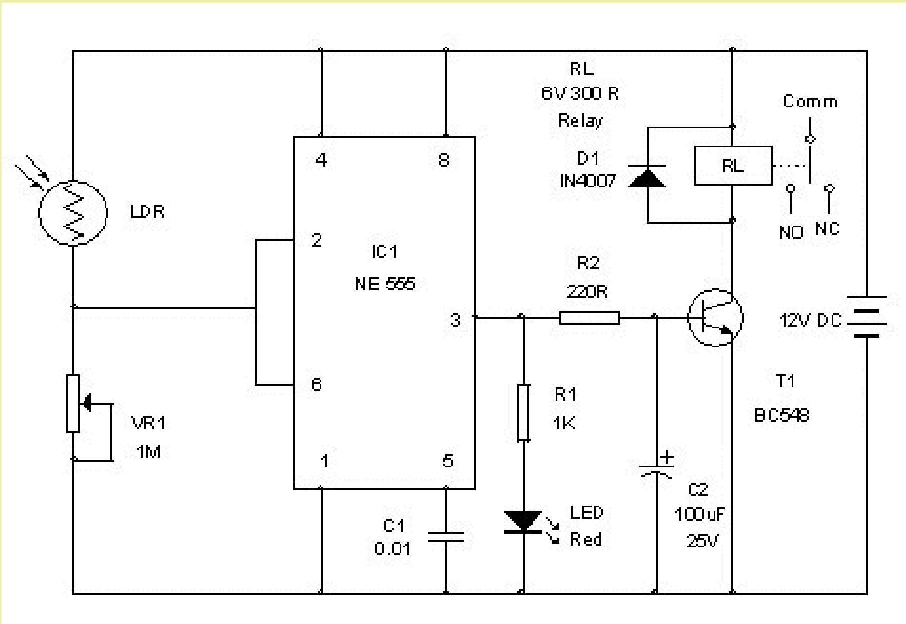
The circuit can be reduced to 2 components:

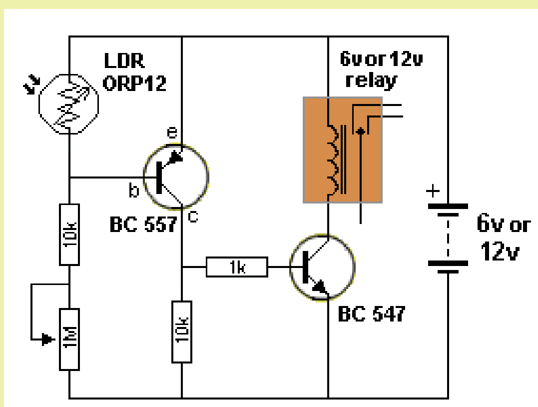


The 7805 can be converted into a content-current device by connecting a resistor as shown above.
We will take the operation of the circuit in slow-motion to see how it works.
As the 12v rises from 0v, the 7805 starts to work and when the input voltage is 4v, the output is 1v as a minimum of 3v is lost across the 7805. The voltage rises further and when the output is 5v, current flows through the 15R resistor and illuminates the LED. The LED starts to illuminate at 3.4v and the voltage across the 15R at the moment is 1.6v and the output current will be 100mA. The input voltage keeps rising and now the output voltage is 7v. The current through the LED increases and now the voltage across the LED is 3.5v. The voltage across the 15R is 3.5v and the current is 230mA.
The input voltage keeps rising and the output voltage is now 8.6v The current through the LED increases and the voltage across the LED is now 3.6v. The voltage across the 15R is 5v and the current is 330mA. The input voltage keeps rising but a detector inside the 7805 detects the output voltage is exactly 5v above the common and the output voltage does not rise any more. The input voltage can rise above 13v, 14v . . . . 25v or more but the output voltage will not rise.

If the output voltage rises, more current will be delivered to the LED and the voltage across the 15R will increase. The 7805 will not allow this to happen.
The LED will have 3.6v across it. The 15R will have 5v across it and the output will be 8.6v. The input voltage will have to be at least 12.6v for the 7805 to operate.

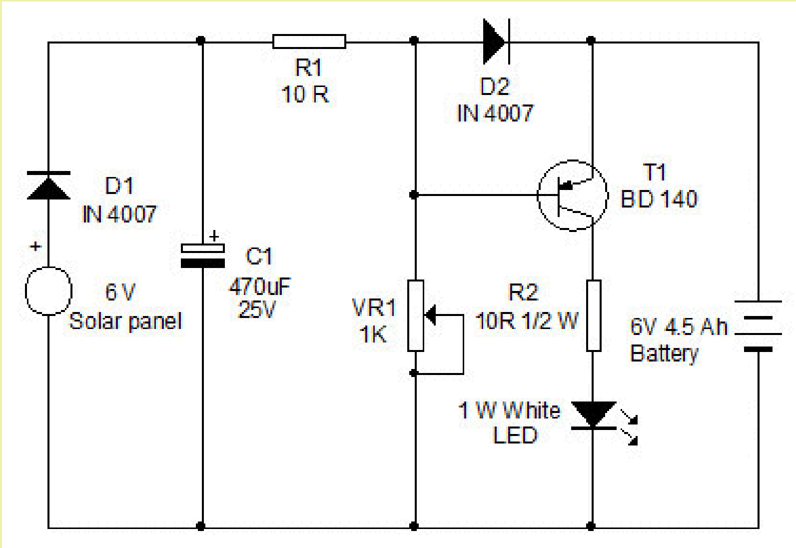
Here's another over-designed circuit by Professor D.Mohan Kumar.
The 555 is consuming 10mA all the time and this is very wasteful when using a 12v battery.





The transistor circuit consumes less than 0.1mA when the relay is not activated. It is also simpler and cheaper to construct.

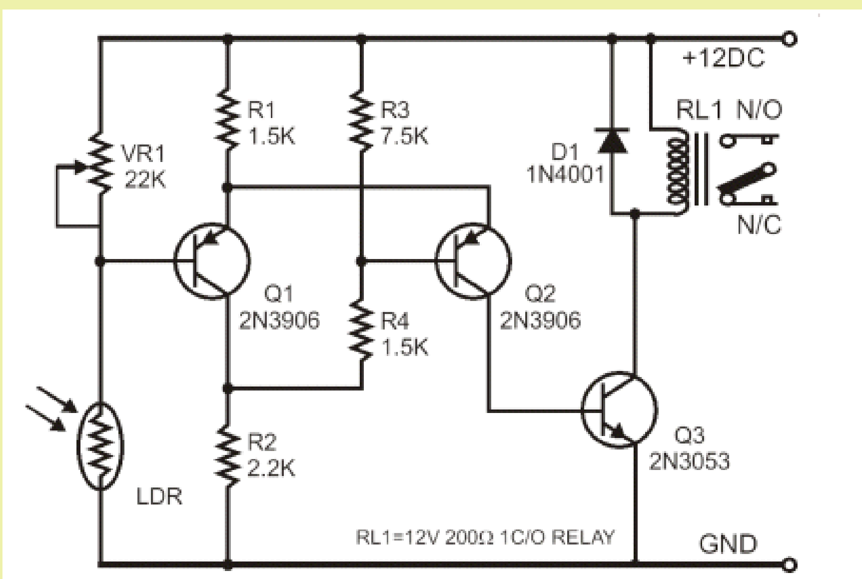
Another over-designed circuit by Professor D.Mohan Kumar. SOLAR NIGHT LIGHT



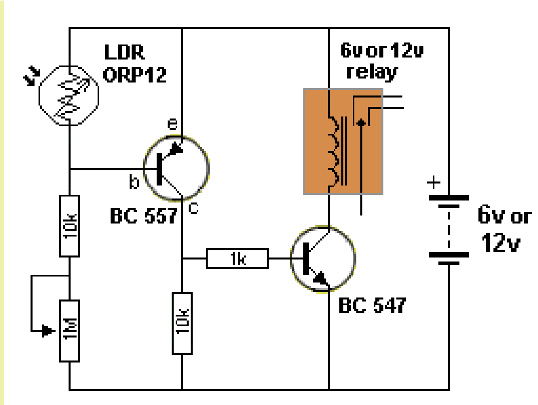
1. What is the purpose of D1? It is not needed.
2. What is the purpose of C1? It is not needed.
3. If the LED is 1w and has about half rail voltage across it, R2 will also have half rail-voltage across it and it needs to be 1 watt also.
4. Turn VR1 to zero ohms and it will burn out via the emitter-base junction of T1.
5. A 4.5Ah battery needs to be charged at about 400mA. 400mA flowing through R1 will produce a voltage drop of 4v. The 6v solar panel will never charge the 6v battery.

This is just a junk circuit that will never work.

Here's an interesting circuit. Let's look at the design.
The first two transistors are connected to form a **PNP Schmitt Trigger**. This give a fast action to the relay. But this is not needed. The action of the relay turns ON and OFF in the second circuit without any problem and it does not need a diode across the relay because the transistor is turning OFF slowly.



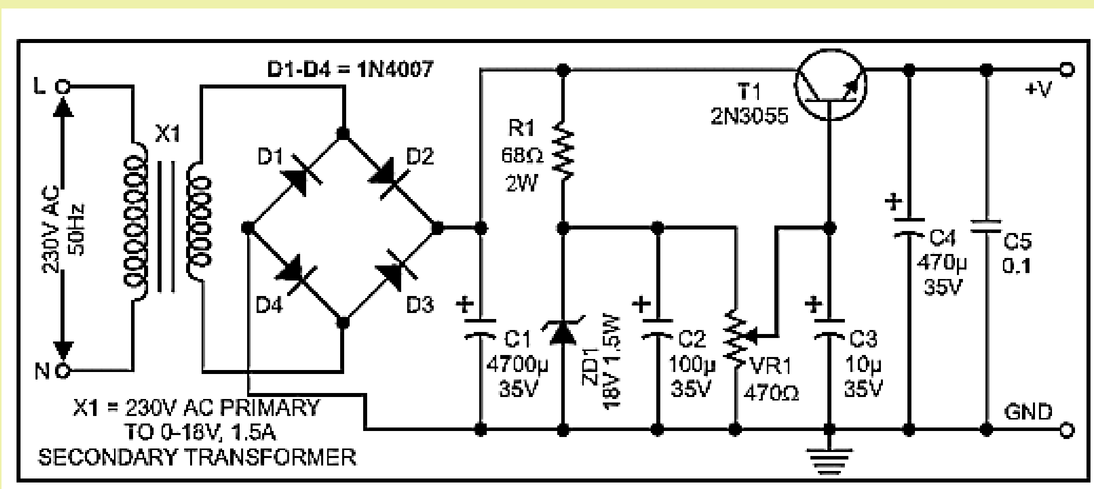
Firstly, you don't need 3 transistors to operate a relay from an LDR (Light Dependent Resistor).
When light falls on the LDR, the relay turns OFF.
Here is a circuit that turns OFF a relay when light fall on the LDR and requires only 2 transistors:



Let's look at the first transistor in the 3-transistor circuit:

When no light falls on the LDR, the transistor is OFF.
The voltage divider made up of the 7k5, 1k5 and 2k2 puts 4v on the base of the second transistor. This turns ON the second transistor and the emitter will be about 4.6v. This will turn ON the third transistor and also the relay.
As light falls on the sensor, it forms a voltage-divider with the 22k.
The emitter of the first transistor is 4.6v and when the base is 4v due to the resistance of the LDR, the first transistor starts to turn ON. This increases the voltage across the 2k2 resistor and has the effect of turning OFF the second transistor. The voltage across the 1k5 reduces and turns ON the first transistor slightly more. After a short period of time the first transistor is turned ON FULLY and the second transistor is fully tuned OFF. This action occurs without the LDR changing resistance. This is the action of the Schmitt Trigger.
The circuit does work but is over-complex for the requirement.

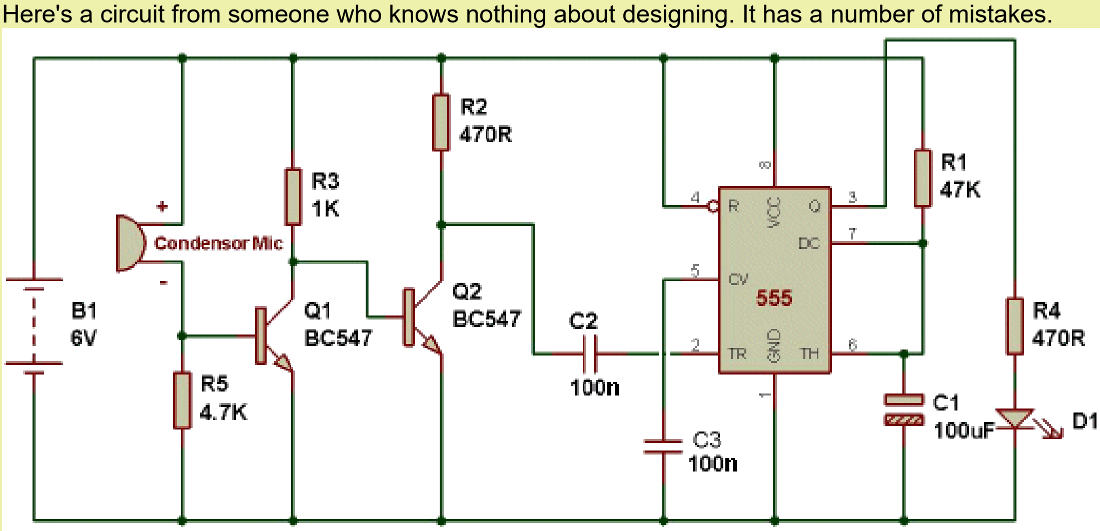
Here's a circuit from **Electronics Maker**, an Indian magazine. It looks fairly workable at first glance, but let's look into it in more detail:



The transformer is not referred to as "Secondary: 0-18v." It is simply 240v:18v. An 18v secondary will normally be 5v higher than the rating to account for voltage-drop under load. This means the output will be 23v and when this is rectified, it will produce a voltage of 23 x 1.4 -2v = 30v.
The 68ohm resistor will drop 30v - 18v = 12v. The current though the 68R = 175mA.
This current will also flow through the 18v zener. The wattage dissipated by the zener will be:
18v x 0.175 = 3.15 watts. The circuit specifies 1.5watt. The zener will be damaged !!
The 2N3055 has a gain of about 50.
Suppose you turn the pot to produce 9v. It will be at approx 235ohms.
When the transistor is delivering 1A, the base current will be 1,000/50 = 20mA. This current will flow through the 235 ohms of the pot and the voltage drop will be: .02 x 235 = 4.7v.
The output voltage will DROP 4.7v !!
This is a typical JUNK CIRCUIT. It has not been tested and no-one from the magazine has picked up the mistakes.
For a 1Amp Power Supply, it would be much better (and cheaper) to use a 3-terminal regulator such as LM317. It is adjustable from 1.2v. It has almost no drop in output voltage and the ripple is about 5mV.
Here is a kit using the LM 317 regulator. You can see the two different inputs (power plug and flying

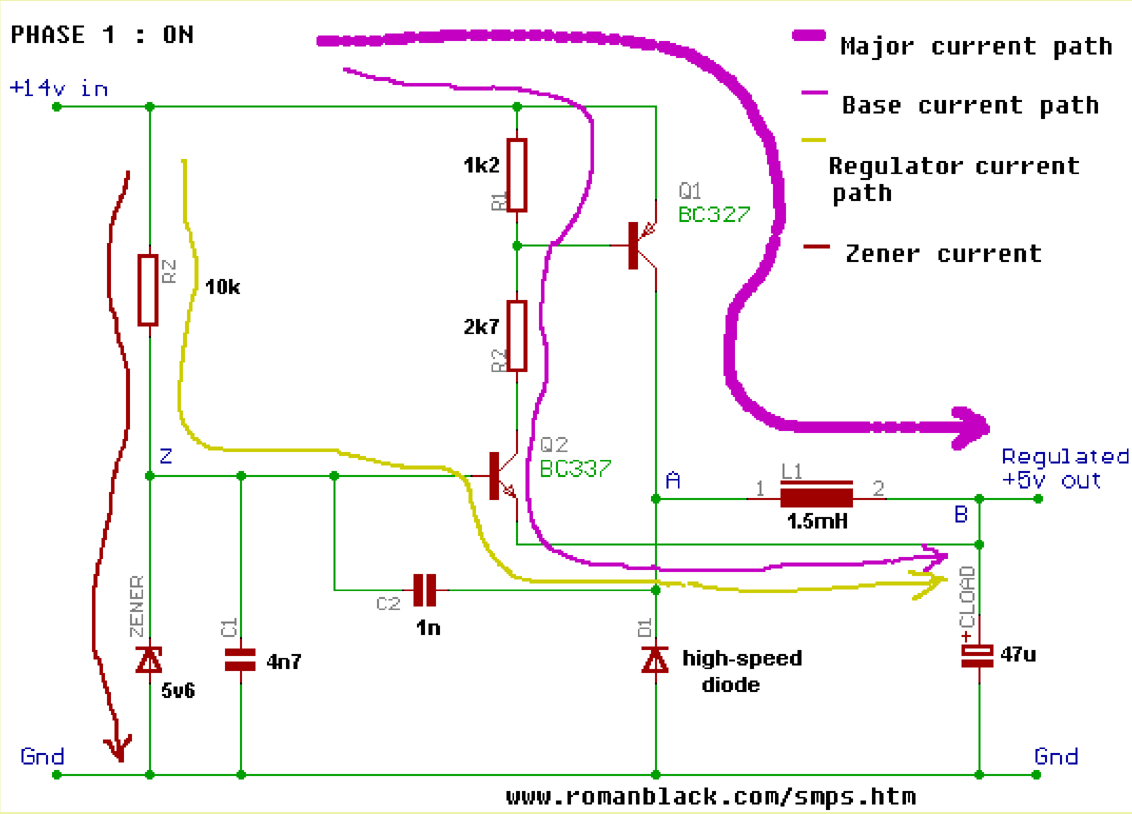
leads), WO4 bridge rectifier and pot to adjust the output voltage. The regulator will need a larger heat-fin if you want to deliver more than 200mA.

Here's a circuit from someone who knows nothing about designing. It has a number of mistakes.



The condenser microphone is actually called an electret microphone and it will be totally damaged in the circuit above.
It is connected directly across the supply with a base-emitter junction of the fist transistor. It needs a 10k resistor in series with the microphone.
It is not a good idea to connect the microphone directly to the input of the transistor, however it can be done. The transistor must be only lightly turned-on so the signal can be amplified.
This is very hard to judge and if a series resistor is adjusted from 10k to 1M, you will see the change in output signal.
This is a huge range and will depend on the type of microphone. That's why you cannot present a circuit with such a wide range of values.
The 4k7 resistor is not doing anything and can be removed.
The 1k and 470R resistors are too low. They should be 22k to 47k.
Pin 2 of the 555 is not being held HIGH via a 100k so it can be taken LOW via the signal from the second transistor.
The whole circuit is a bad design. It is taking 10mA when sitting around and does not offer an ON-OFF feature but simply a delay when a clap is detected. The circuit should be avoided.

Here is a 2-transistor Switch-Mode Power Supply from Roman Black. He has shown the operation of the circuit using 4 diagrams but they do not actually explain HOW THE CIRCUIT WORKS. In fact the diagrams are hard to decipher and misleading. He is a correct description of the operation of the circuit.

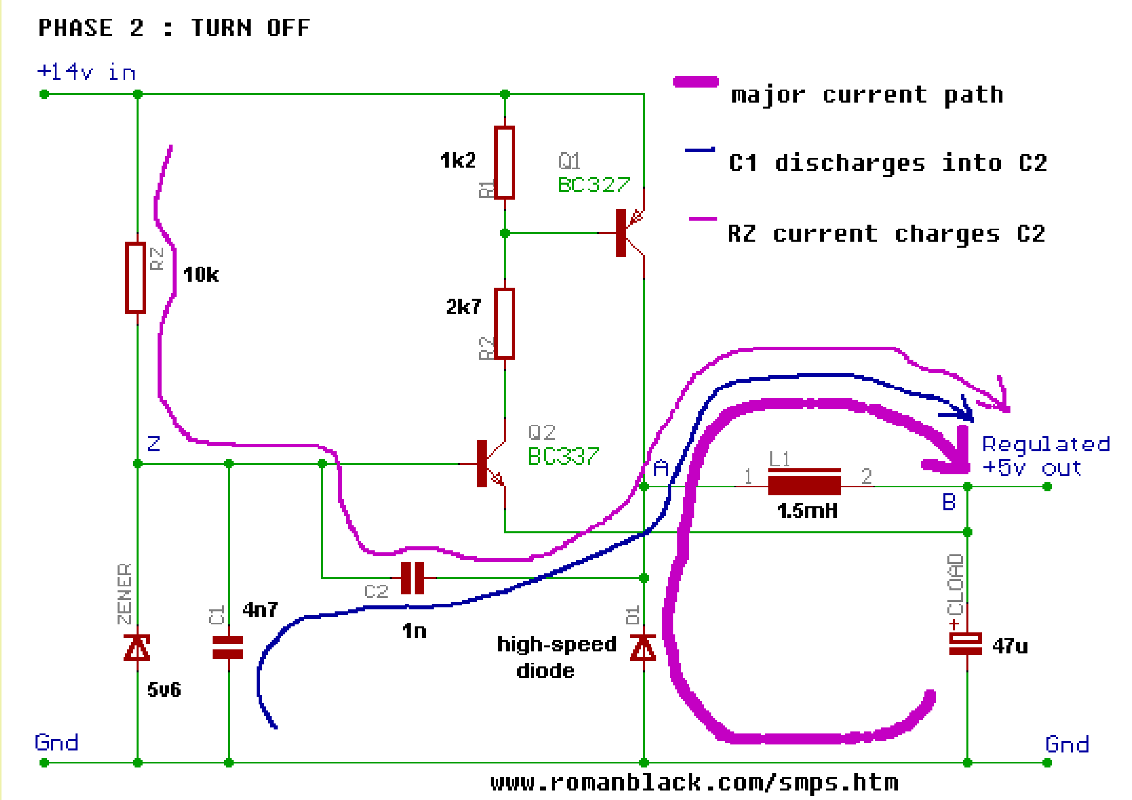


The circuit shows 2 transistors, an inductor L1 and high-speed diode D1.
Here's how the circuit works:

PHASE 1: ON

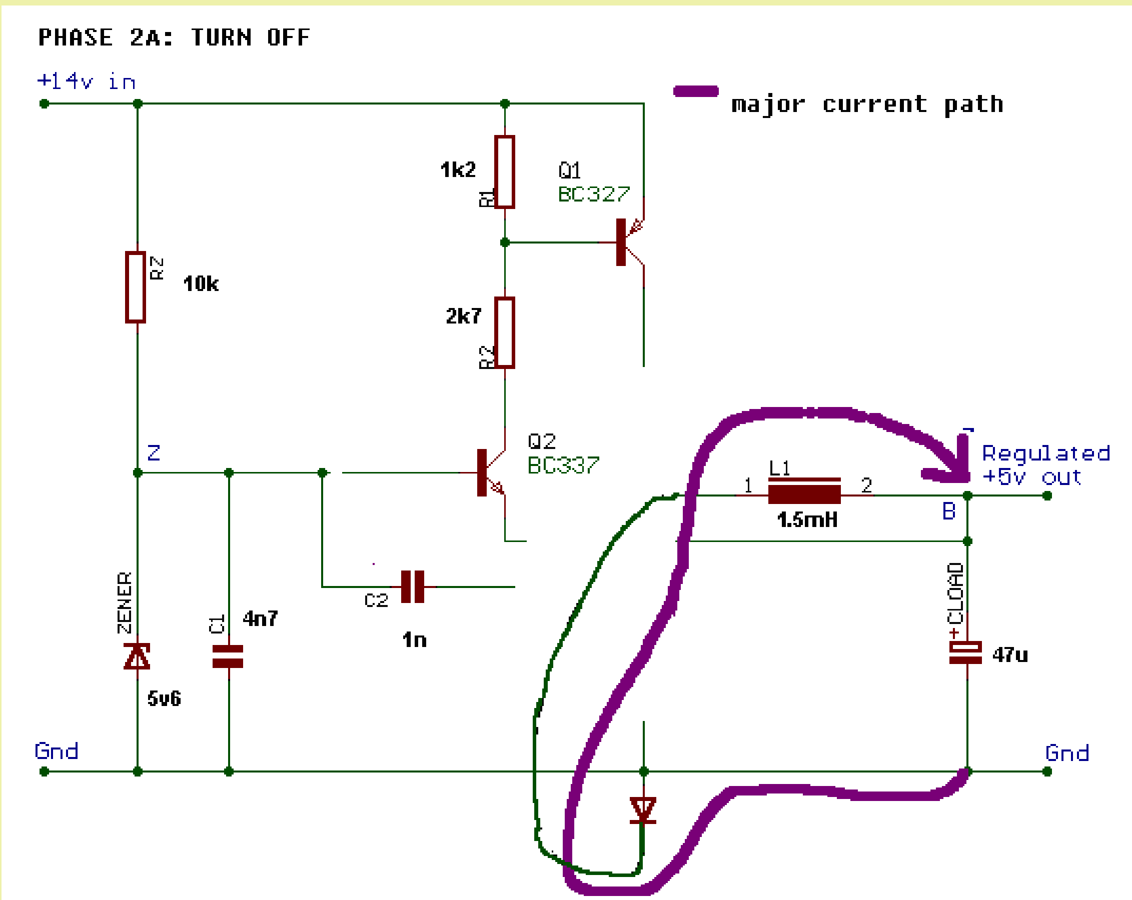
The circuit does not turn on until the output is slightly less than 5v. The voltage on the base of Q2 is 5v6 and the emitter is slightly less than 5v. This produces a slightly higher base-emitter voltage and causes Q2 to turn ON. This turns on Q1 via the 2k7 resistor.
Current flows through inductor L1 and it builds up a magnetic flux. This magnetic flux produces a voltage across the inductor that is almost equal to the difference between the 5v output and the supply. This allows Q1 to turn on. The inductor can keep producing this "back voltage" until the the core becomes saturated. At this point the back voltage suddenly ceases and the right plate of the 1n drops a small amount. This is transferred to the base of Q2 to turn it off slightly.
This action continues between the two transistors until they are both fully turned off.
The large purple arrow is correct.
The thin purple arrow is vague and the description of the yellow arrow is a mystery.

PHASE 2: TURN OFF



The arrows above are vague and misleading and incorrect. See Phase 2A below for correct description.

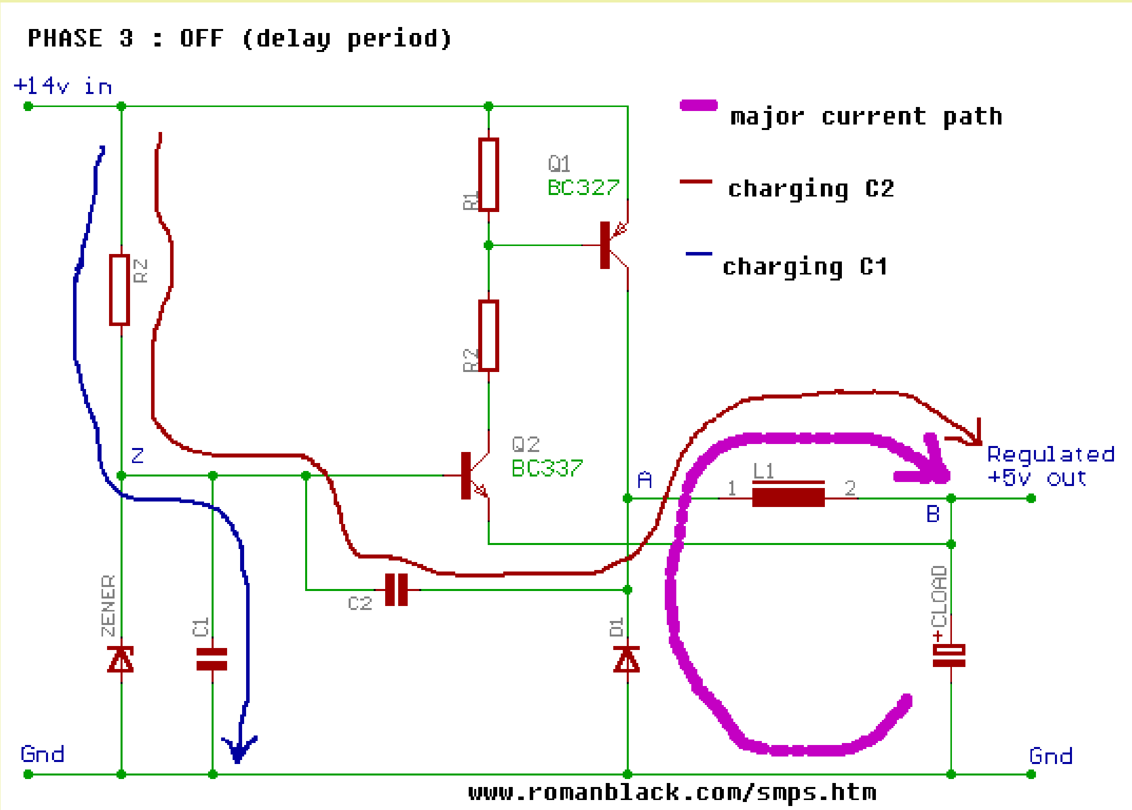
PHASE 2A: TURN OFF



When the two transistors turn off, the magnetic flux in the inductor collapses and produces a voltage IN THE REVERSE DIRECTION to the applied voltage. This means the left side of the inductor produces a

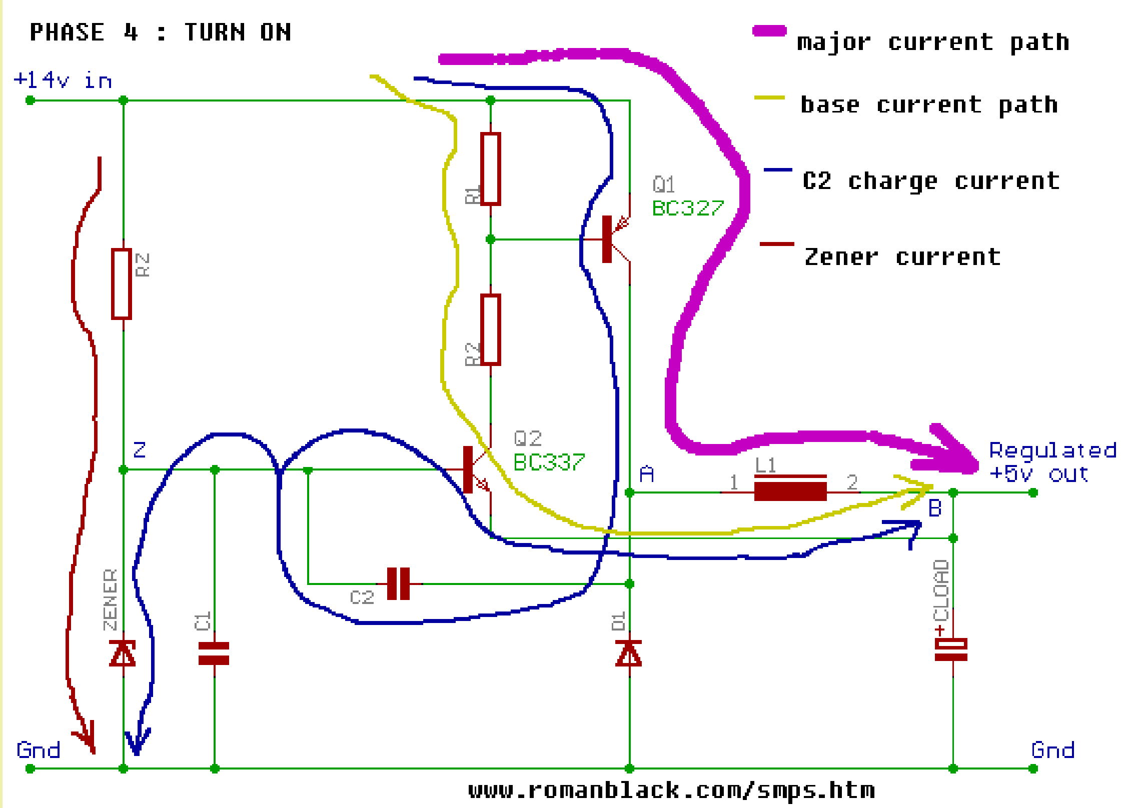
voltage that is LESS THAN 5v. This pulls the voltage on the base of Q2 lower and turns off the transistor even MORE. At the same time it charges the 1n and C1 is discharged slightly.
If the voltage on the left side of L1 reaches -0.6v, the high-speed diode "flips-over" and starts to conduct. This stops the left side of the inductor creating a higher negative voltage and now any energy produced by the inductor is passed to the 5v regulated output. This is how the energy from the inductor adds to the output.

PHASE 3: OFF (Delay Period)



I don't know what is trying to be explained in Phase 3. I don't know what the author means by "Delay Period" He thinks the delay period is set by C1, C2. This is not so. The releasing of the energy from the inductor sets the time for this part of the cycle.
Both C1 and C2 are charged by a very small amount by Rz.

PHASE 4: TURN ON



The energy in the inductor is very soon passed to the output and the voltage across L1 reduces. The voltage on the right-hand side plate of C2 rises from -0.6v and the energy in C2 charges C1 and turns on Q2.
The yellow base-current path does not pass through R1 but the emitter-base junction of Q1 passes about 1mA and R1 passes about 0.5mA.

As you can see, arrows on a diagram are misleading and meaningless. The author did not have an understanding of the operation of the circuit and this confused me greatly.
I could not follow the operation. That's the purpose of a language. It explains things clearly and accurately.

I did not receive a reply until a reader posted this discussion on an electronics website.
Roman replied on the website:
"I had just chosen to ignore it, believing my description was fairly accurate and easy to understand."
Things cannot be "fairly accurate" They are either accurate or not.
Roman replied to some of my comments and got himself further entwined in inaccuracies. That reinforced my comment that he did not know how the circuit worked.
He said: "The turning off phase involves the discharge of caps. As the buck turns off, the inductor pin point A slams below 0v, this causes C1 to discharge and the +ve voltage in C1 to cause a current through C2, as shown by my blue arrow."
The "turn off" phase is a transitory phase where C1 energy is dumped through C2 causing the voltage on point Z to drop sharply as C1 energy is dumped through to the load.
This is entirely untrue.
The timing of the "Off Period" is controlled by the energy in the inductor.
Refer to Phase 2A where I have shown the high-speed diode sits below the 0v rail and will have -0.6v on the cathode.
The right lead of the 1n will drop from about 12v (in one direction) to -0.6v (in the other direction) and this 13v is called "energy" and it will discharge the 4n7 by an amount equal to the ratio of the two capacitors. That's why the 4n7 drops about 3v. The voltage on C1 will go below the zener voltage and the 10k will provide a small current to "top up" C1 and C2. This means that the energy in the two capacitors will be slightly more than at the beginning of this part of the cycle and when the energy from the inductor has been fully released, the voltage on the cathode of the high speed diode will start to rise due to the voltage on the electrolytic on the output and the resistance of the inductor. As the voltage rises, the energy in C2 will be passed to C1 and the voltage on the base will rise to 5v6. The energy will do two things. It will pass into the zener diode and also into the base of Q2 to turn it ON.
This turns on Q1. This raises C2 to turn on Q2 further. The small amount of energy provided by the 10k Rz resistor provides the energy into the base of Q2 to start the next cycle.

Roman further states:

It is common in SMPS buck ICs to use a "timed off" period, usually a monostable. I managed to mimic this effect by the combination of C1 and C2 and the energy dump as explained in Phase2. Once C1 has dumped and is at 3v, there is a clearly defined "delay period" while C1 charges again (via RZ) and during this delay period the buck Q1 remains off. This gives a big drop in frequency and improves efficiency for a number of reasons, and also greatly increases stability.
Roman is mixing up the defined "timed off" period in a buck IC circuit with the 2-transistor circuit above. The capacitors C1 and C2 have no effect on the frequency. The frequency is generated by the time it takes to release the energy from the inductor during the "turn off" period.
He says: "The "turn off" phase is a transitory phase where C1 energy is dumped through C2 causing the voltage on point Z to drop sharply as C1 energy is dumped through to the load." This is incorrect. The energy is not passed to the load as the right hand end of C1 is connected to the cathode of the high-speed diode and it is CONDUCTING during this part of the cycle and the energy from C1 is being LOST. This is a clear factor that he does not understand the operation of the circuit.
I have been criticised for stating this FACT, but how else can you describe an article that is COMPLETELY WRONG!
He believed his descriptions were "fairly accurate."
You be the judge.

1. He never once mentions the fact that the inductor produces a reverse voltage. This is the crux to the operation of the circuit.
2. He never shows the high speed diode "flipping over" and conducting.
3. He concentrates on current through the 10k entering the load. This is less than 1mA.
4. He thinks the frequency of the circuit is generated by C1 and or C2. This is not so.
5. He says energy from C2 is dumped into the load. This is not so. It is LOST.
6. He says the charging of C2 is via Q1, but initially it is via the electrolytic (at the load).

In simple terms, the operation of the circuit is this:

The high voltage from the supply is passed to the load via the inductor.
The two transistors turn on very quickly and the current flows to charge the electrolytic on the output.
This current passes through the inductor and produces magnetic flux.
This magnetic flux produces a "back voltage" that allows Q1 to turn on fully. At a point in time the core of the inductor becomes saturated and the "back voltage" ceases. At this point the voltage on the collector reduces and this is passed to the base of Q2 via the 1n capacitor.
The two transistors turn each other OFF and the magnetic flux collapses and produces a voltage in the opposite direction.
The rest of the cycle has been covered above.

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SPOT THE MISTAKES!

Page 14

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These pages have become bigger than I expected.
Although they receive a very small portion of the readership of this site, they form a very big part of the knowledge-base.
Most text books try to cover the operation of a circuit by using mathematics. But if you are a beginner, this concept is way over your head.
The whole of Talking Electronics website is designed to talk about circuits and explain their operation with NO mathematics.
And it has been a huge success.
The readership of the site is increasing every month with over 2,000 visitors each day last year and now it is nearly 6,000 each day.
It is more important to be able to talk about how a circuit works than be able to solve a mathematical equation.
This fact is highlighted in some of the faulty circuits we have presented on this page.
Highly educated electronics teachers (in the circuits below) show a total misunderstanding of how a circuit works and somehow they muddle through a lecture, leaving the students in a daze of bewilderment.
All they have to do is read through this website and their lectures will change from absurd to comprehensible.
Until that happens we will be scouring the web for more terrible designs and add more pages to this ever-increasing file.

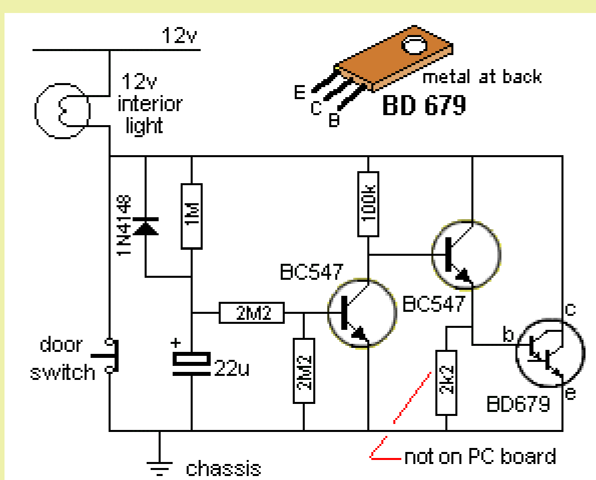
You can learn a lot from other peoples mistakes.
I have repaired over 35,000 electronic appliances over a period of 25 years and most of the problems were due to design-faults.
The most recent task involved a constant-current LED power supply. It produced an output voltage of 65v and a current of 350mA. You can connect between 10 and 20 1-watt LEDs to the module.
But the modules were constantly failing.
Two faulty modules and a good module were sent to me for assessment.
On opening them up it was immediately obvious that the soldering to the leads to the triac were faulty. They had not used enough solder and the slight heating and cooling of the triac had caused one of the leads to become "dry-joint."
This was obvious on all three units.
This is a very difficult problem to solve, especially with the new requirement to use non-leaded solder.
This type of solder is much more prone to cracking and producing dry joints as the lead in the solder produces a more-flexible joint. When you don't have lead, you have a very big problem.
The only solution is to open up the modules and re-solder the connections with a leaded solder and a very hot soldering iron.
This is not allowed under the rules of certification, however the importer of these modules has no other option - the fail-rate was so high that the cost of replacing the units at each location was sending him bankrupt. Even replaced units were failing.
To make the units 100% reliable, I would also solder a very fine strand of tinned copper wire from the tip of each lead of the triac to an adjacent land on the PC board. I know this is time-consuming but it works out cheaper than the cost of a single "call-out".

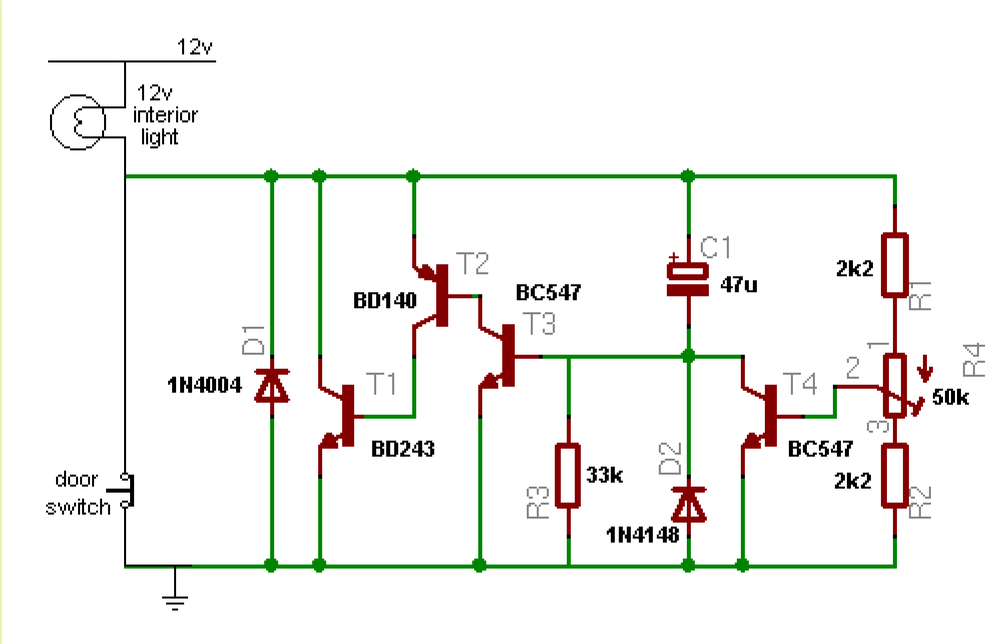
Here is a lecture from a "Professor."

Not only is the description vague but he really doesn't know what he is talking about.

He has actually described NOTHING.
Just when I expected him to describe how the base bias resistors were selected, he did not provide an answer.
That's because the circuit is much more complex than you think.
Firstly, you have to remember this:
The energy (current) is not passed to the speaker though the transistor but via the load resistor. The transistor merely discharges the electrolytic (connected to the speaker) so that it can be charged again via the load resistor.
This action creates one-half of the energy cycle, but the load-resistor provides the incoming energy.
To pass energy to the speaker, the load resistor has to be a very low value.
If the speaker is 8R, and the load resistor is 8R, we have a starting point where the speaker and load resistor are connected directly across the power rails with the electrolytic between them.
If the load resistor is increased, less current will flow to the speaker.
If the load resistor is 100R, less than 10% of the maximum current will flow to the speaker.
Now we understand how the energy gets passed to the speaker.
The next point to understand is the value of the base resistors.
To continue this discussion, see: **The Transistor Amplifier**

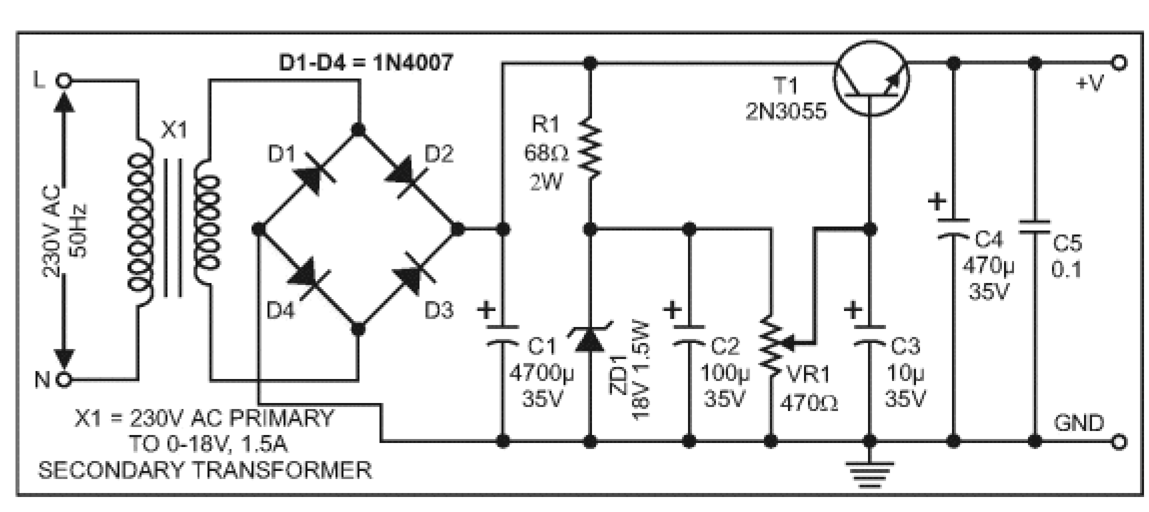
Here's an example of unnecessary components:





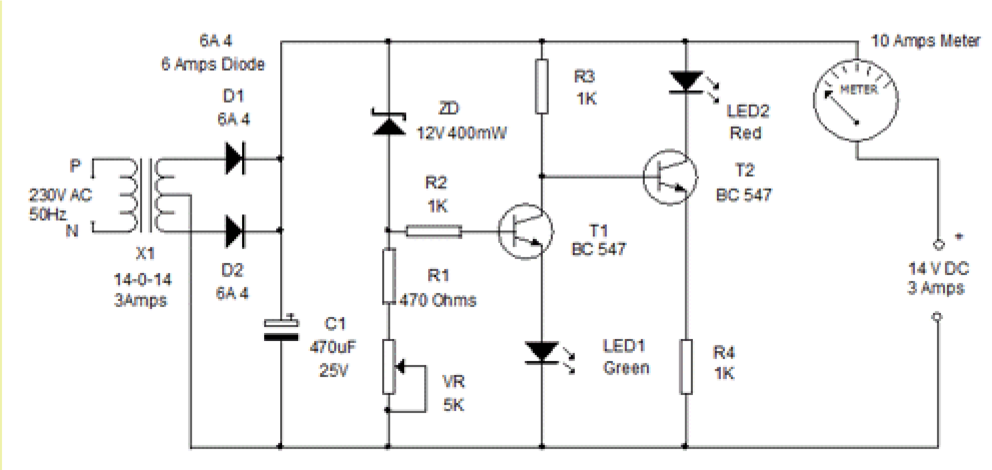
The first circuit is mine.
It is a courtesy light extender for cars.
The second circuit is from PC Heaven.
I don't know who designed it, but it has a number of components that are not needed.
When the door-switch is opened, the 47u is uncharged and it charges via the globe and base-emitter junction of the T3.
This turns on T2 and T2 turns on T1.
All these transistors turn on but T1 does not fully turn ON as it would produce a voltage of only about 0.2v across the circuit. It turns ON so that 0.6v is available for the the base-emitter junction of T3 and a little bit more for C1 so that is starts to charge and pass a current though the base-emitter junction of T3. The voltage across the circuit is possibly about 1v.
During this time T4 does not come into operation.
As the 47u charges, the current though the base-emitter junction of T3 reduces and the transistor turns off slightly.
This turns off T2 and T1 a small amount. The voltage across the circuit increases, and the interior light dims a small amount.
This continues until the voltage across the circuit reaches 11v4 and the globe goes out. The 33k resistor continues to charge the 47u to 12v and the voltage across the base-emitter junction of the T3 falls to 0v.
T4 and the 50k pot will reduce the time-delay.
D1 is not needed.
The 50k pot could replace the 33k and T4, and 2 x 2k2 resistors can be deleted.
This means 5 components are not needed.

Here's a circuit with a hidden fault.

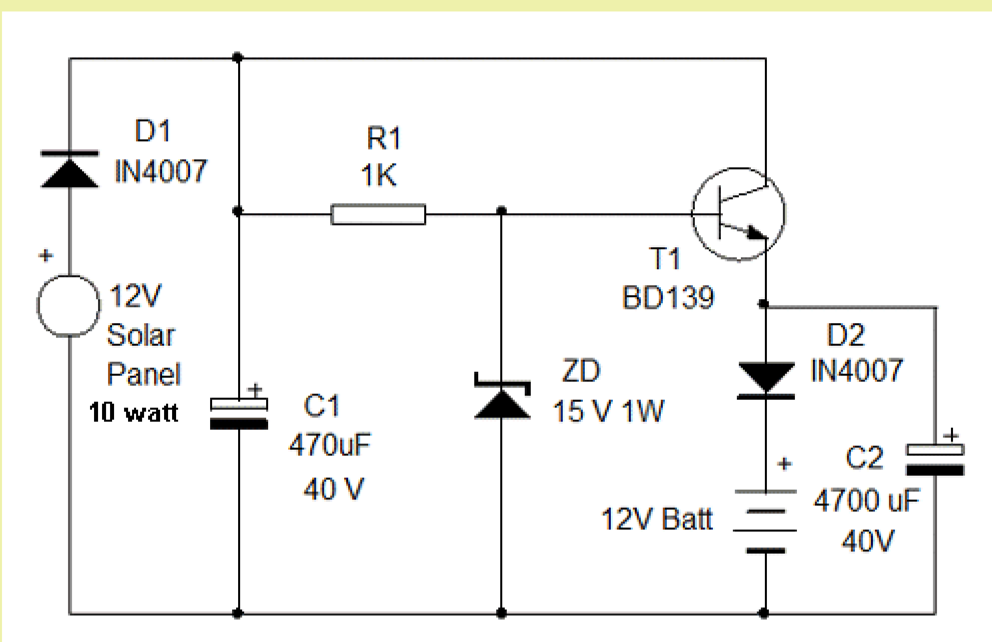


The fault is the 68R - the voltage-dropper to the 18v zener.
The 18v transformer will produce 18v x 1.4 = 25v and the bridge will drop 2v.
The current through the 68R will be 23 - 18 = 5/68 = 70mA
This current will flow through the zener.
But how much current is required by the 2N3055?
The power supply will only deliver 1 amp max due to the 1N4007 diodes in the bridge.
The current required by the base of the 2N3055 to deliver 1 amp depends on the gain of the transistor and a 2N3055 has a low gain. It is a maximum of 70. Using this value, the base current for 1 amp output will be 1,000/70 = 14mA.
This current is taken from the zener, leaving about 56mA.
This is a very wasteful circuit and the zener will be dissipating over 1watt and getting very hot.
The 68R can be increased to 180R and the zener will not drop out of regulation.
The circuit has an excess of smoothing.
Normally you require about 1,000u per amp for the first (main) capacitor. This allows about 50mV ripple.
The 100u across the zener is not needed as the zener provides about 5mV ripple.
The transistor reduces the ripple by a factor of 70, so the 50mV ripple on the input is less than 1mV on the output. The 470u on the output reduces the ripple to less than 1/10th of a mV.

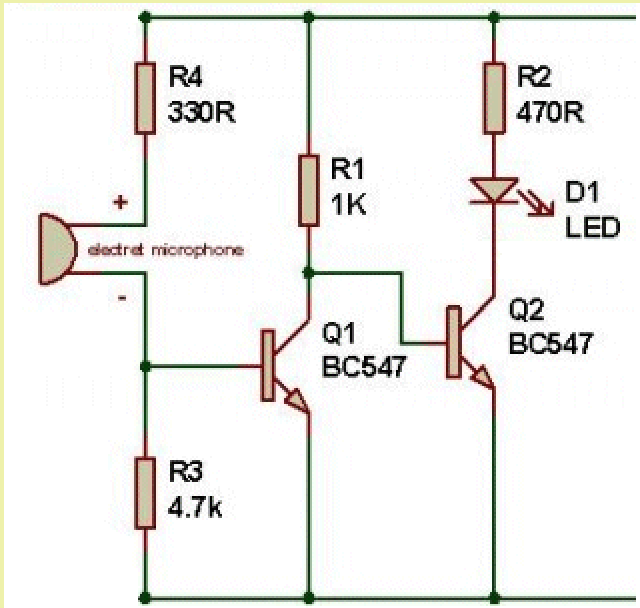
Here's another faulty circuit from D.Mohankumar.
The green LED is supposed to illuminate when the battery reaches full-charge. But the LED will only turn on when the voltage is above: 12v for the zener, plus 0.6v for base-emitter voltage plus 2.4v for the green LED = 15v. The battery never reaches 15v!!
But the biggest mistake with the circuit is trying to charge a 12v battery from a transformer that is not designed EXACTLY for the job.
You simply cannot connect any transformer to a battery and expect it to work. That's because a battery is very similar to a zener diode. If you deliver a slightly higher voltage to either of these devices, a very high current will flow. That's because the battery is a fixed voltage and the transformer is (effectively) a fixed voltage and there is no voltage-dropping component between (such as a resistor). In the circuit below, the transformer will produce 14 x 1.414 = 19.6v minus 0.7v for the diode. This means 18.9v will be delivered to a battery that rises to a maximum of 15v and a very high current will flow.
The transformer will simply overheat and burn out.
Battery-charger transformers are specially wound with the exact number of secondary-turns to provide a charging -current to suit the rating of the transformer.
You CANNOT use an "off-the-shelf" transformer.
Why doesn't he test his circuits. He is a Professor at an Indian University, surely he has plenty of time each day to test everything he produces, instead of making a fool of himself.

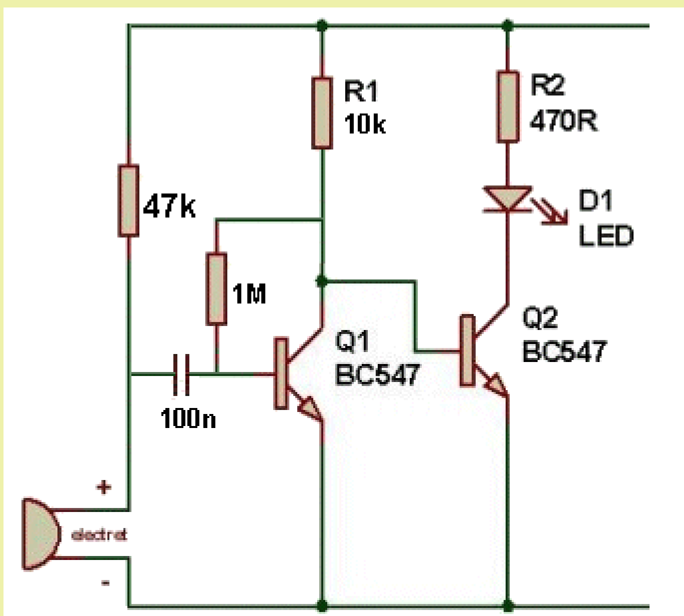


Here's another faulty circuit from D.Mohankumar.
I don't know where he gets his circuits from. But nothing has been tested.
The circuit is supposed to charge a battery when the output of the solar panel reaches 15v. A 12v panel will be as high as 20v on no-load and in bright sunlight the panel will reach 16v when delivering a current. Suppose the battery voltage is 10v (a flat battery). The emitter voltage will be 10.6v.
The base voltage will be 11.2v.
If the panel has an output of 16v, the left side of the 1k base resistor will be 15.4v and the voltage across this resistor will be 4.2v. This will allow 4.2mA to flow. If the transistor has a gain of 100, the collector current will be 420mA.
When the current reaches 500mA, the gain of the transistor falls to between 25 and 70. The only way to get 500mA collector current is to increase the base current to 500/70 = 7.1mA, but this is not possible as the panel voltage would need to be 18.3v But as the current-demand from the panel is increased, the terminal voltage of the panel decreases.
Thus we have a situation where this circuit will not work as expected.
You can see the limiting factor of this circuit is the 1k resistor. It should be a lower value.
Possibly between 180R and 330R.
The purpose of the 470u and 4700u is unknown. They are not needed. You don't need to smooth the pulses when charging a battery.
What is the purpose of D1? It is not needed. D2 already prevents the battery being discharged when the solar panel is not producing a current.
Overall, a very poorly designed circuit.
The transistor will need to be heatsinked as it will get very hot.

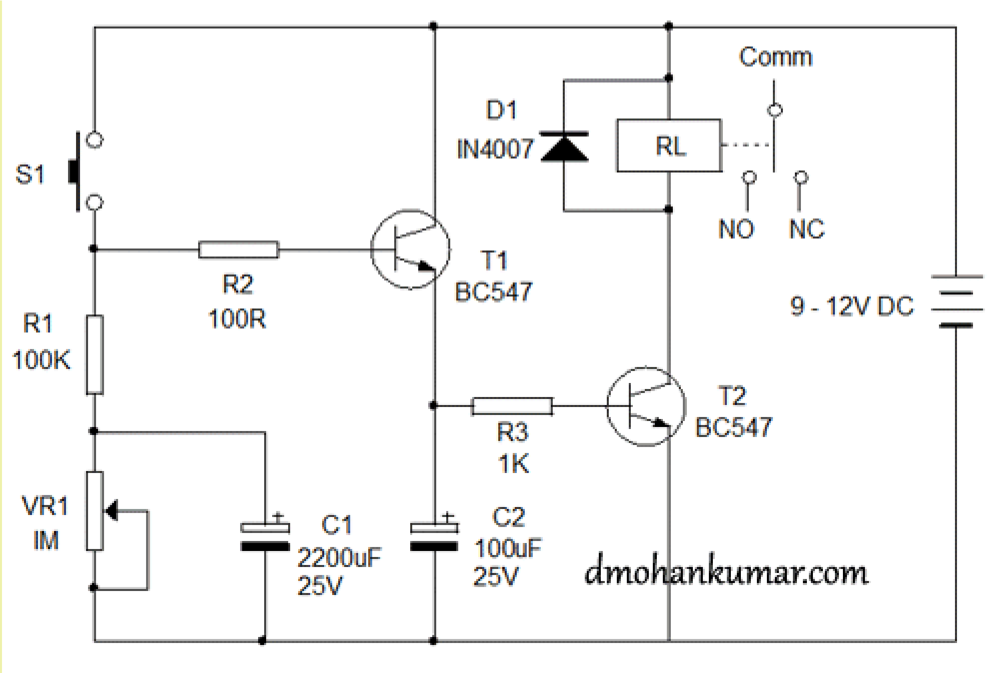


Here is a circuit from Buildcircuit.com
Resistors R3 and R4 should change places as 330R is far too low as the load resistor for an electret mic and the base current is too high for the BC547 transistor.
The load resistor for the mic should be 22k to 47k.
It is not known what effect is trying to be achieved with the circuit but if the LED is to be illuminated with a clap or whistle, the mic should be connected to the input of the first stage via a capacitor as shown in the second circuit. This allows only the AC portion of the signal to enter the two stages of amplification and illuminate the LED.

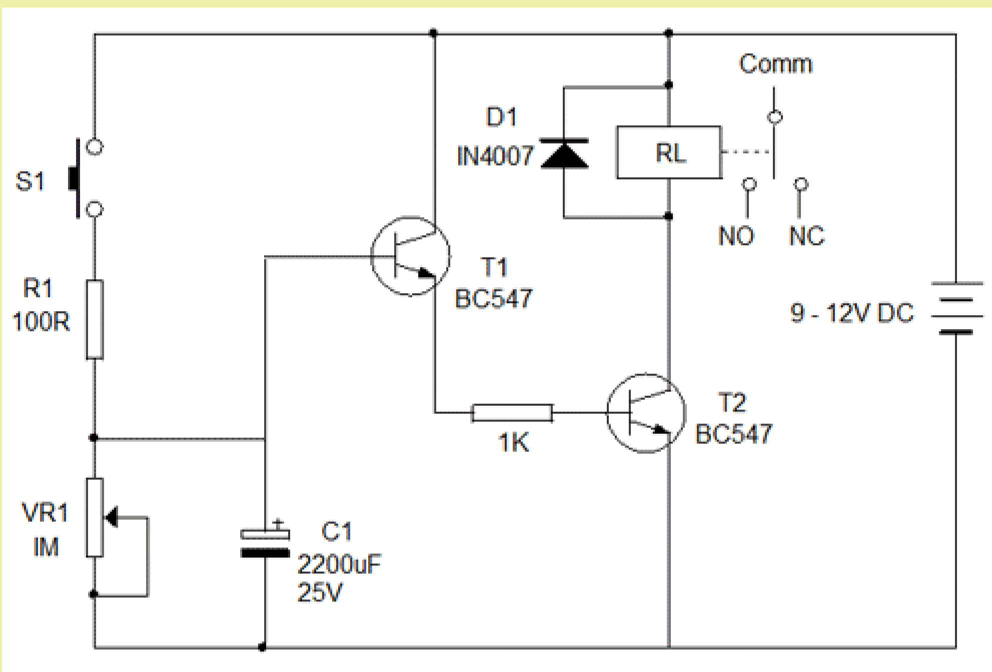




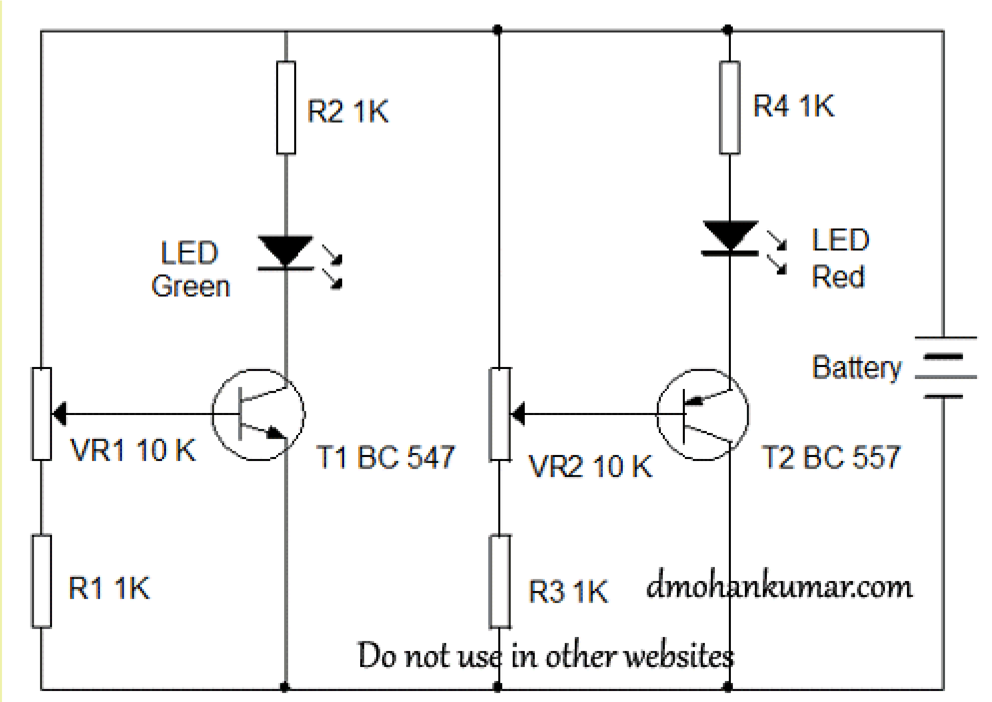
Here's another D.Mohankumar circuit:



His circuits are ideal to show you how NOT TO DESIGN.
The circuit is a terrible design. When the switch is pressed, C1 is charged via R1 but since R1 is such a large value, you don't know how long to press the switch to fully charge the capacitor. C2 will charge quickly but you don't know how long it will hold the relay closed. There may be a gap between these two timings. It's just a messy design.
The circuit can be simplified and improved by removing two components:



Here's another D.Mohankumar faulty circuit.
Nothing of his is ever tested. He is a danger to students of electronics. Professors like him (and those from the US on You Tube, don't realise how ignorant and stupid they are).

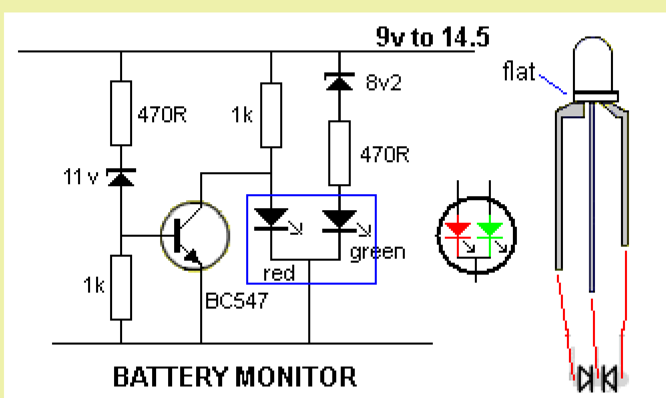


He claims the green LED will turn ON when the battery voltage increases. This is true but of you turn the 10k pot the transistor will BLOW UP!
He claims the red LED will turn ON when the battery voltage decreases. This is NOT TRUE. The red LED will gradually go out as the battery voltage decreases.
Why doesn't he test anything before putting it on the web?

Here are two circuits that work perfectly:

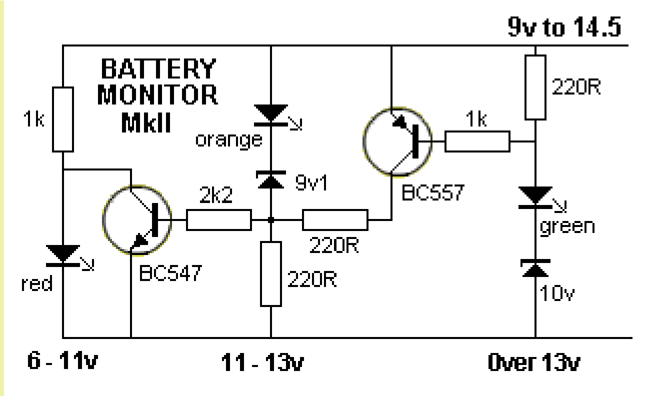
BATTERY MONITOR MkI

A very simple battery monitor can be made with a dual-colour LED and a few surrounding components.
The LED produces orange when the red and green LEDs are illuminated.
The following circuit turns on the red LED below 10.5v
The orange LED illuminates between 10.5v and 11.6v.
The green LED illuminates above 11.6v
Or you can use two separate LEDs and get the intended effect of the circuit above.



BATTERY MONITOR MkII

This battery monitor circuit uses 3 separate LEDs.
The red LED turns on from 6v to below 11v.
It turns off above 11v and The orange LED illuminates between 11v and 13v.
It turns off above 13v and The green LED illuminates above 13v



Here is an Infrared LED driver circuit. It has a few mistakes.

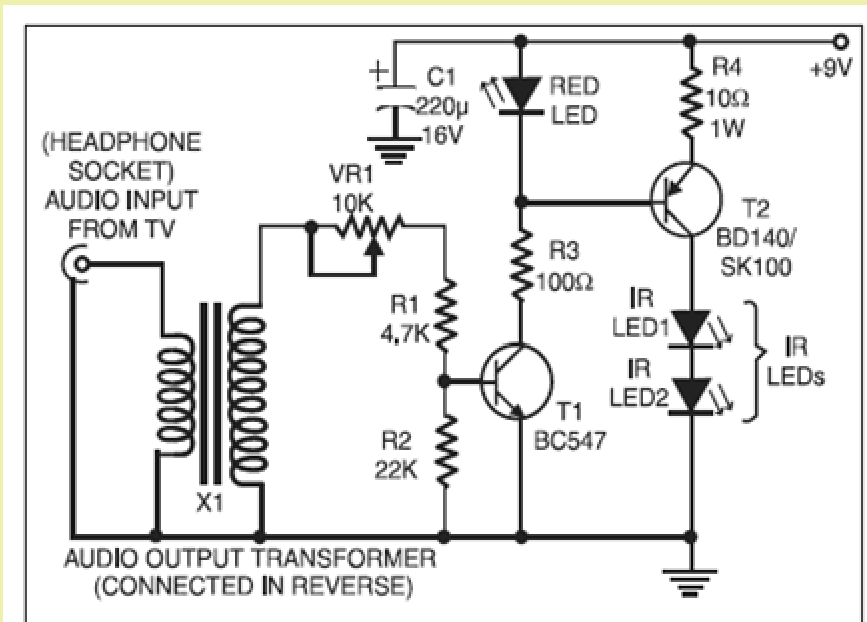
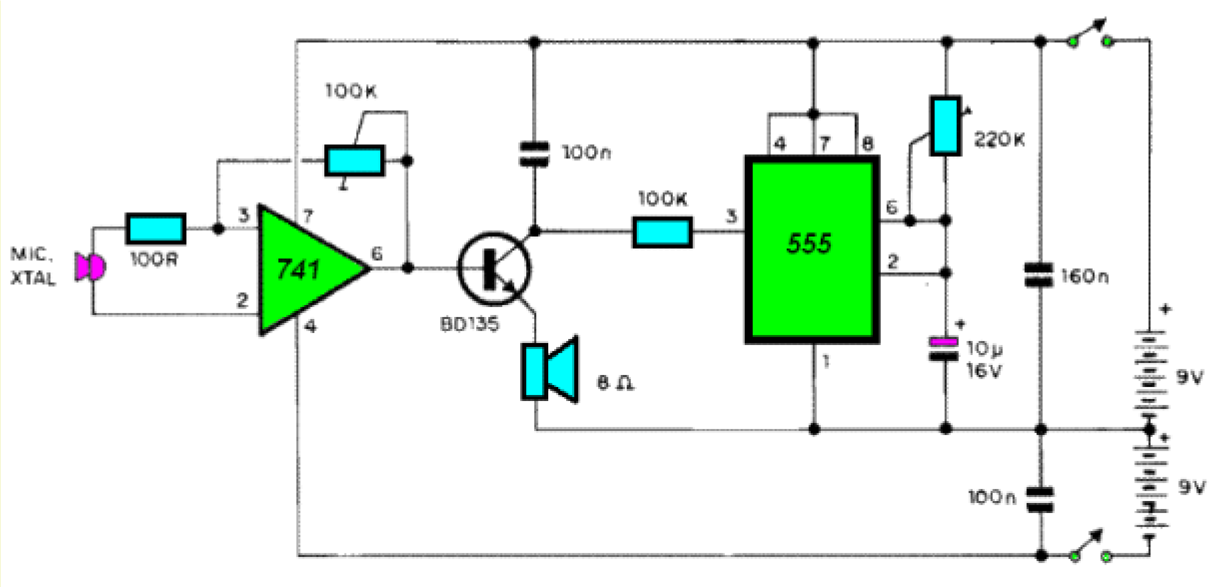


FIG.1: IR Audio Transmitter

The audio transformer is 8R:1k and the 4k7 on the base of the first transistor is not needed. R2 is also unnecessary.
R3 will allow 70mA to flow through the red LED if the first transistor turns on fully. This value should be increased to 330R.
The red LED, in conjunction with T2 and R4 form a constant-current arrangement to produce a maximum of 100mA through the two Infrared LEDs.
100mA through a 10R resistor dissipates 100mW so a 1watt resistor is not needed.
T2 passes a maximum of 10mA so a BC547 transistor will be sufficient.
All these little things show the person who designed the circuit did not know much about designing.

Here's a faulty circuit from the web. It is a VOICE CHANGER.

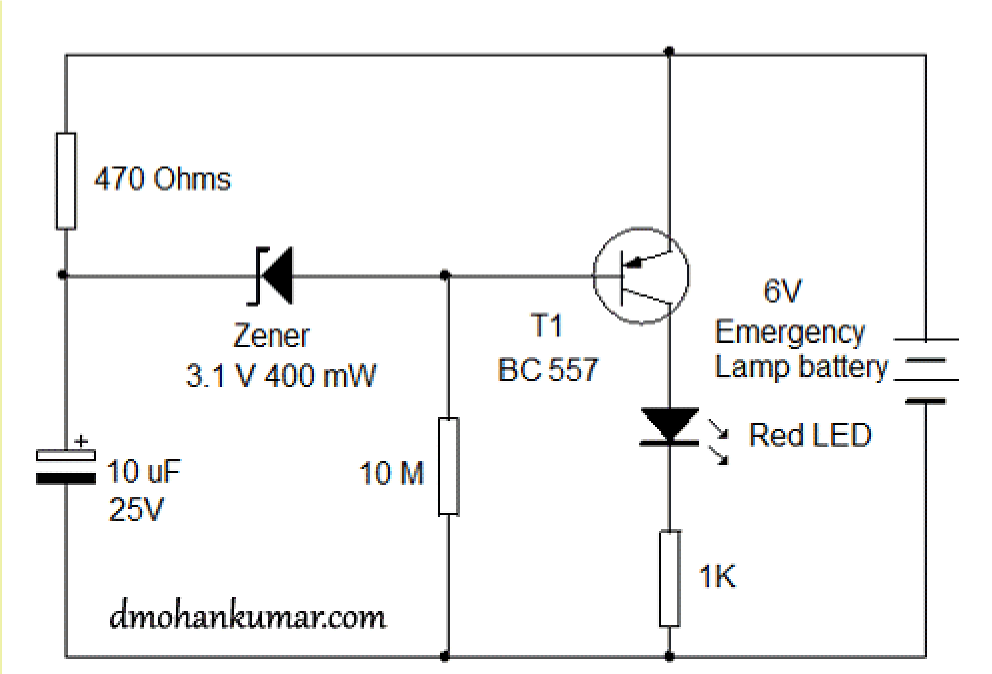


Pin 7 of the 555 is connected to the positive rail. This pin has a transistor that takes pin7 LOW during each cycle and should be connected to pins 2 and 6 to discharge the capacitor (10u electrolytic). The chip will be instantly destroyed if pin7 is connected to the supply.
The 100k on pin 3 will have almost no effect on driving the 8R speaker and the output of a 741 op-amp is a maximum of 25mA to 40mA.
Xtal Mic's went out of production 25 years ago. They are a very high impedance device. What is the point in putting 100R in series with a 5 Meg Xtal Mic?
The circuit obviously has never been tested, it contains so many mistakes.

Here we go again with another D.Mohankumar faulty circuit.

Here is his comments about the circuit:

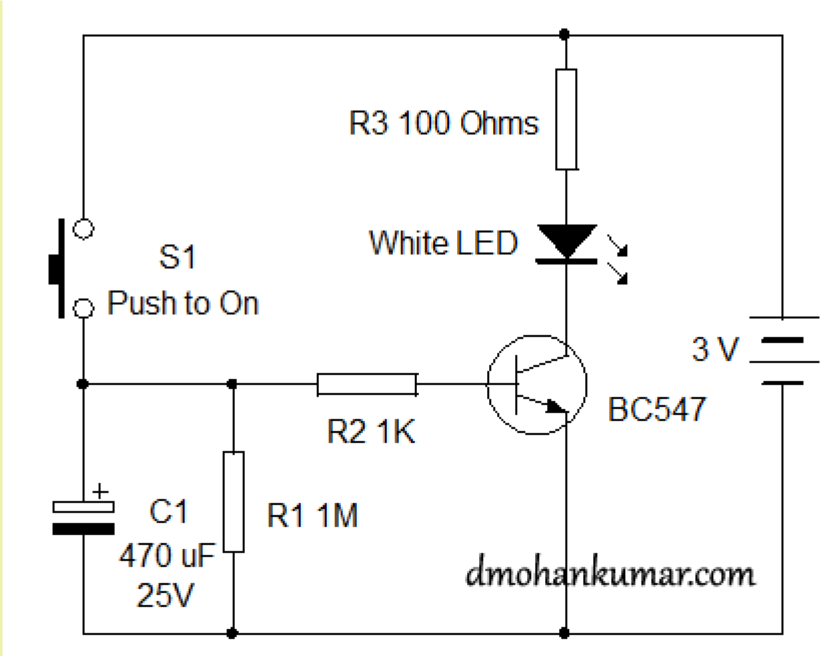
This simple circuit gives an **LED indication** when the 6v **emergency lamp battery** enters into the **deep discharge** state. As long as the battery voltage is above 4 volts, LED remains off and it turns on when the battery voltage drops below 4 volts.
When the battery voltage is above 4 volts, the **Zener** conducts (the Zener requires around 1 volt excess than its rated voltage for complete breakdown) and the base of the PNP transistor BC557 remains high and it will be in the off position. Since T1 is off, LED remains dark . When the voltage in the battery drops below 4 volts, zener turns off and T1 turns on and LED lights.



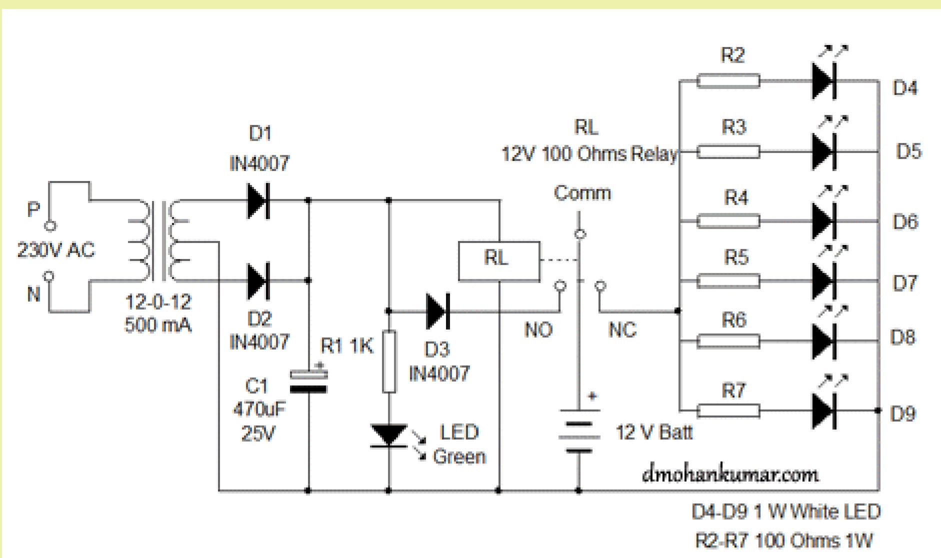
LOW BATTERY INDICATOR

Everything he says is incorrect.
Here is the fault: The zener will allow a voltage of 3v less than rail voltage to appear on the base of the transistor **if you mentally remove the transistor from the circuit.**
But the transistor only needs 0.6v less than rail voltage to turn on.
This means the transistor will be turned on when the battery voltage is 6v, 5v and 4v. The circuit DOES NOT WORK.
The second problem is the 10M. It is too high. The transistor effectively amplifies the current through the 10M (6uA) by the gain of the transistor. Suppose the gain is 300. This means the transistor will allow 6uA x 300 = 1.8mA to flow through the collector-emitter circuit and illuminate the LED.
The LED will not be very bright!
"(the Zener requires around 1 volt excess than its rated voltage for complete breakdown) " - this is complete rubbish. Don't believe anything Professor D.Mohankumar says.
I don't know where he gets these terrible circuits from. They are certainly an insight on: "how not to design."

Another D.Mohankumar faulty circuit.
This circuit contains two faults.
The first mistake is technical. The value of the 1k resistor is too low. The circuit is a timing circuit. **It is a short duration timer which turns on the white LED via the push-button and after a 1 minute it automatically turns off**.
The delay circuit consists of the 470u and 1k resistor. The 1k resistor should be increased to 10k to produce the longest delay for a 470u electrolytic.
The second problem with the circuit is the 3v supply. A white LED requires 3.2v to 3.6v for full illumination, however some will work on a voltage lower than 3v and still produce some output. However it is not wise to suggest this circuit to beginners as it may fail to operate.

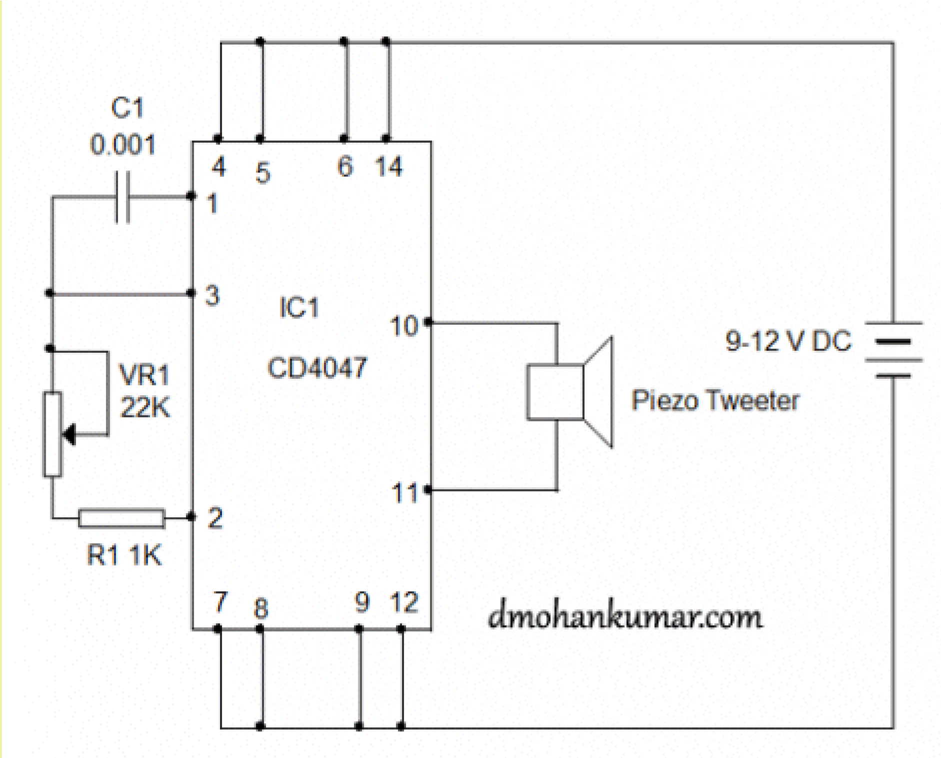


Another D.Mohankumar faulty circuit.
The circuit uses a relay and the battery is being charged when the supply is present. When the supply fails, the battery illuminates the 6 LEDs.
This circuit contains two faults.
The first mistake is the lack of a current-limiting resistor to the battery. A 12v transformer will produce over 20v when not loaded and will deliver more than 500mA to a 12v battery.
In fact it will possibly burn-out.
The white LEDs are claimed to be 1-watt. However one-watt LEDs take 300mA and 100R resistors will only deliver 90mA.
Three LEDs can be placed in series on a 12v supply and this will make the circuit 300% more efficient.
Just another untested circuit from Professor D.Mohankumar.

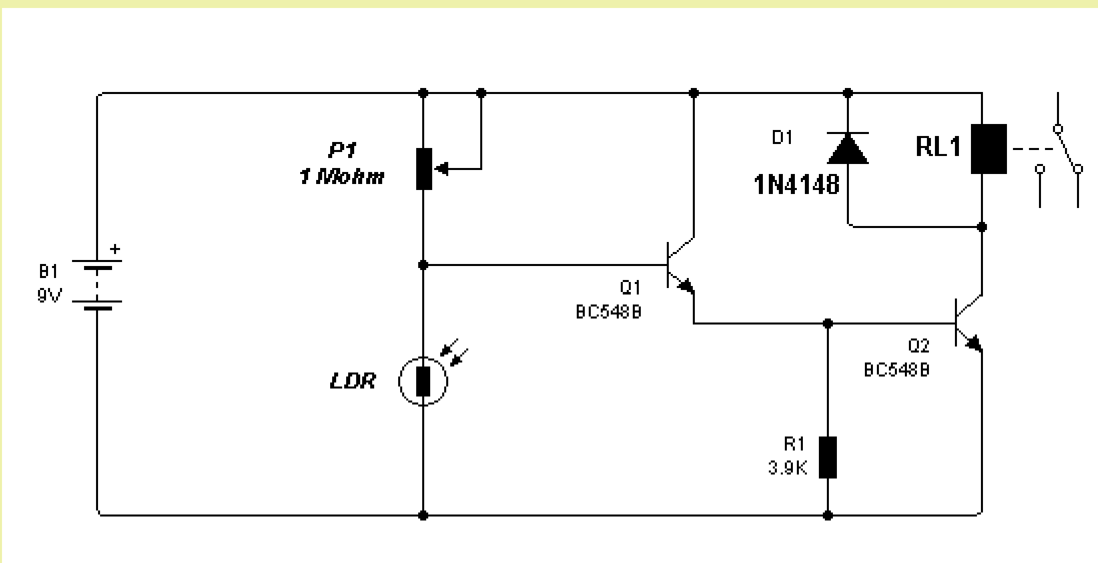


EMERGENCY LAMP

Every circuit Professor D.Mohankumar produces is faulty.
He tests nothing.
Here is an example. The CD4047 chip will only deliver 5 -10mA from the outputs and the piezo output will be worthless:

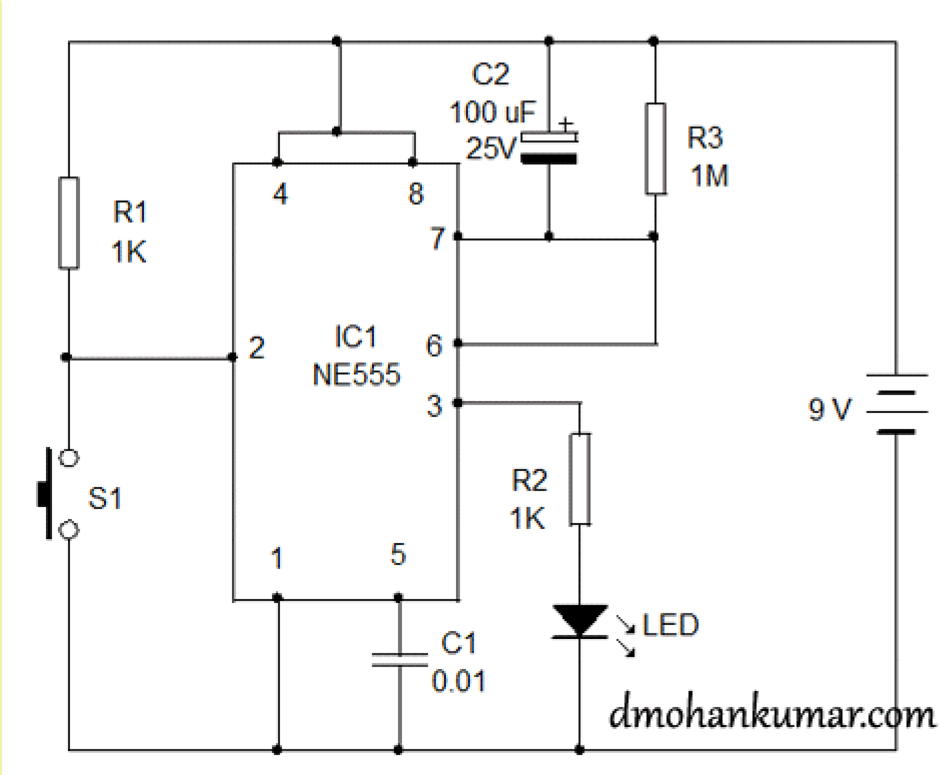


Here's another faulty circuit from the web. It turns ON a relay when light is NOT detected by the LDR.
But if the 1M pot is turned fully clockwise the two transistors will BLOW UP.



Another mistake in the comprehension of electronics from Professor D.Mohankumar

Although the following circuit will work, his understanding of the operation of the 555 is incorrect.
This is a very good example to help you understand the operation of the 555.



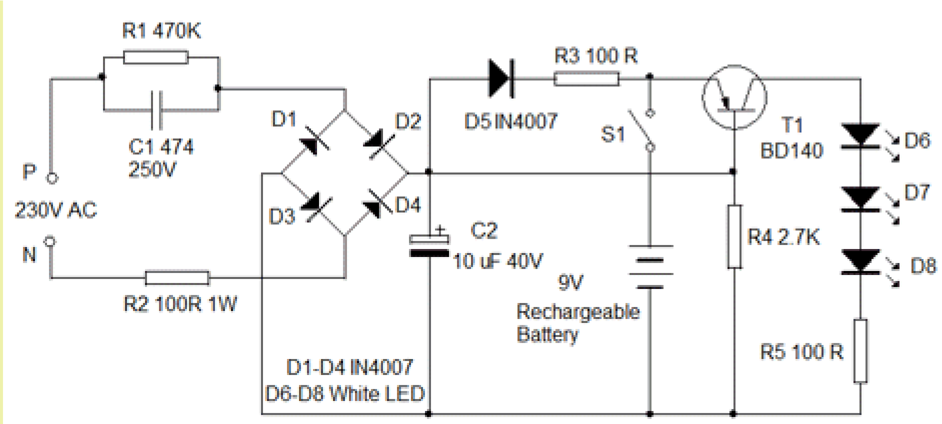
He has the concept of the 555 **ALL WRONG**.

The time delay in 555 Monostable depends on the values of the timing resistor connected to its Threshold pin (pin6) and the timing capacitor between pin 6 and 0v rail.. The time taken for charging the capacitor determines the time delay.

He says:
Just reverse the connection. The **timing capacitor is connected between the positive rail and discharge pin**. So the time delay depends on the **charging of capacitor**. It will take **6-8 times longer** than the typical Monostable.

This is totally incorrect.
Placing the capacitor between the positive rail and discharge pin will create exactly the same timing.
The only difference is the capacitor will get DISCHARGED via the timing resistor instead of being charged during the timing cycle.
However the actual level of voltage that will be removed from the capacitor will still be 2/3 of the supply voltage and it will take the same time to remove this amount of energy from the capacitor as it would take to charge the capacitor from 0v to 2/3 of rail voltage.
It takes the same time to discharge a capacitor from fully charged to 1/3 charged as it takes to charge an empty capacitor from 0v to 2/3.

Another circuit from Professor D.Mohankumar that has not be tested.



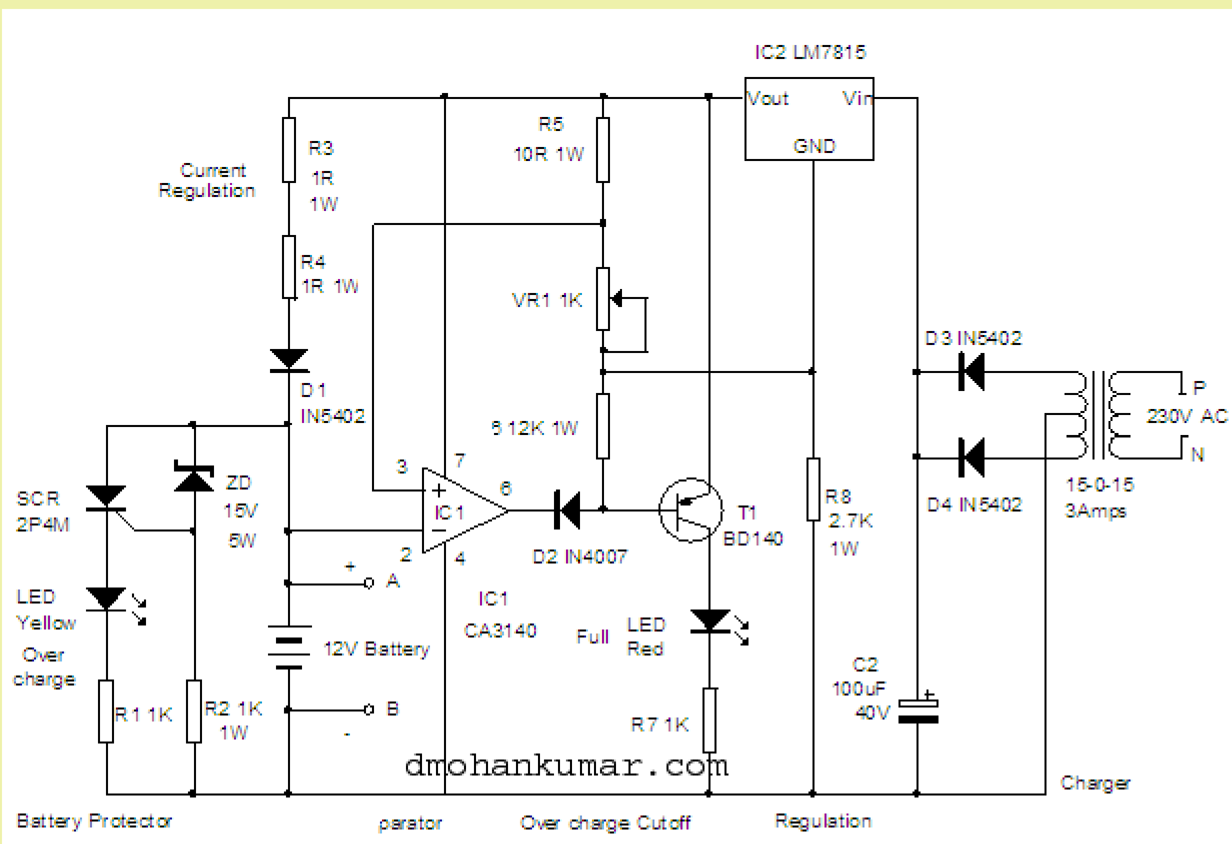
High Volt AC Circuit - Shock hazard if touched

The LEDs turn on when the supply fails.

Here are the faults:
1. The circuit will not work because 3 white LEDs need 3.2v to 3.6v each.
2. R3 is not needed. It does nothing.
3.You don't need a BD transistor as the current is only 30mA.
4. The charging current of 30mA is too high for some 9v rechargeable batteries.

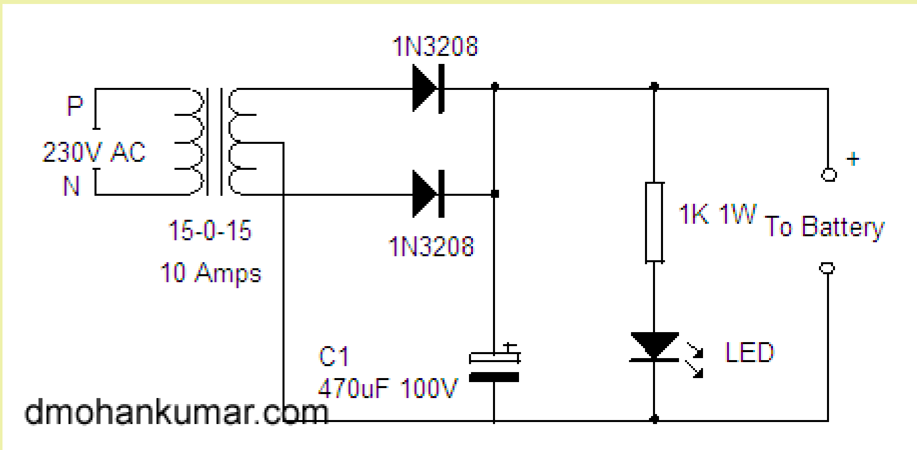
The voltage needed to turn on 3 white LEDs is 3.2v x 3 = 9.6v plus the voltage drop across the emitter-collector junction of the BD140 transistor (0.2v) = 9.8v.
The voltage drop across the 100R when 30mA flows will be 0.03 x 100 = 3v.
On top of this, a 9v battery will drop to 8.5v very quickly, so it is a very bad choice.
This circuit will NEVER WORK.
A maximum of 2 white LEDs can be used.

Another circuit from Professor D.Mohankumar that has not be tested.



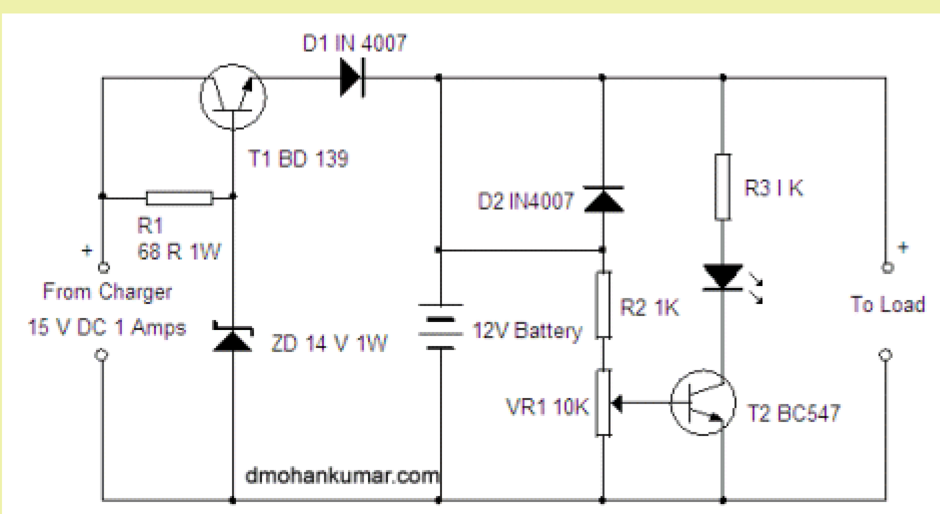
Not only will circuit fail to work but if the output of the IC goes LOW, it will be instantly damaged as the voltage from the regulator will will pass through the transistor and diode D2 and blow the IC up.
He also says the SCR and zener act as a CROWBAR. They do not. He doesn't know what he is talking about.
Why is the zener 5watt????
Why is is R5 1watt?????
He claims the circuit is high current. The 7815 is limited to 1 amp. Why does he use 3 amp diodes in the supply???
The circuit is an absolute disaster.
When will he stop putting this rubbish on the web???

Here's another absurd circuit from Professor D.Mohankumar
It is a 10amp battery charger.



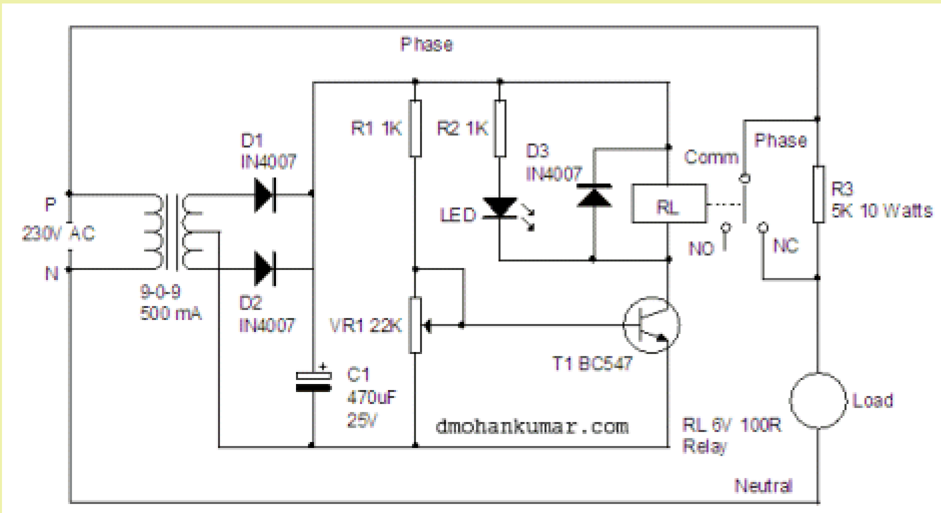
A transformer to charge a battery is a very special design and the output voltage is carefully determined by winding the exact number of turns to deliver the current-capability of the transformer when the battery voltage is low and the current reduces when the battery voltage reaches 15.5v.
You cannot connect an "off-the-shelf" 10 amp transformer to a battery.
You can think of a battery as a 15.5v zener.
If you deliver a voltage of say 15.6v to a 15.5v zener, it will "take" or "allow to flow" an infinite amount of current and since the 15v-0v-15v transformer will deliver over 22v to the battery, an enormous amount of current will flow.
The current will not be limited to 10 amps but it will be exactly like putting a short-circuit on the output of the transformer and it will deliver so much current that it will overheat and BURN OUT.
This circuit is an extremely bad design AND MUST NOT BE USED.
Professor D.Mohankumar has absolutely no idea what he is designing.

Every circuit Professor D.Mohankumar puts on the web is faulty.
Here is a battery charger:



The output from the BD139 will be 14v - 0.6v = 13.4v
Diode D1 will drop another 0.6v, making the charging voltage 12.8v. This voltage will NEVER charge a 12v battery.
He claims R1 sets the charging current. This is not true. R1 simply provides current to the zener to maintain 14v across it.
What is the purpose of D2???? It is connected across a short-circuit !!!!
The circuit DOES NOT WORK.

Here's another circuit from Professor D.Mohankumar



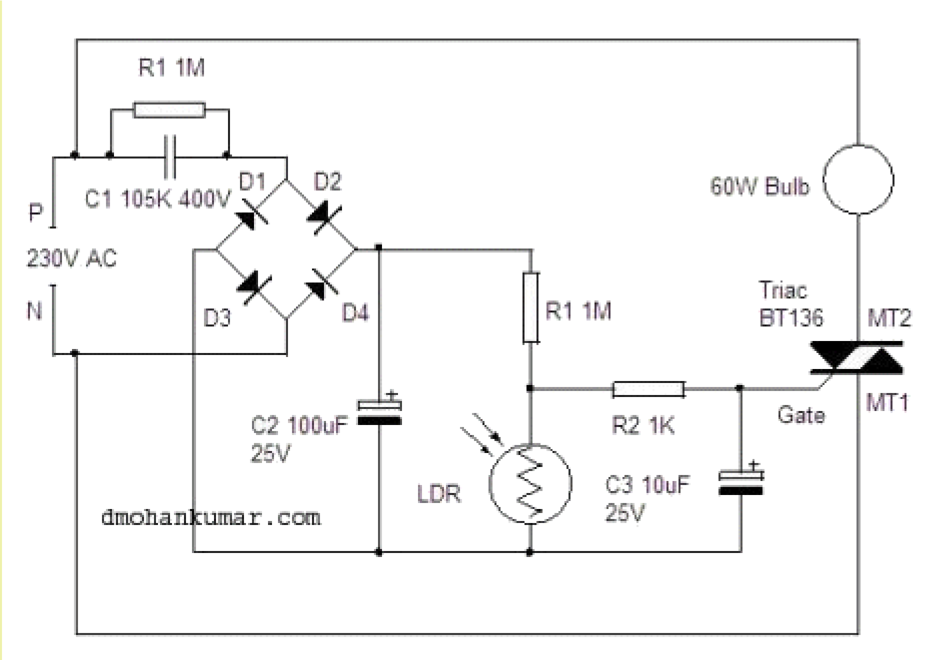
Protect your LCD TV from over voltage. After a power failure or during lightening, very high voltage surge develops in the Mains line which is the major cause that damage TV's. Plasma and LCD TV's are costly devices and use SMPS type power supplies. The use of a stabilizer is recommended for LCD TV's.
However this low cost circuit can do the job of protection very well. When the mains voltage increases above 250 volts, it will drop most of the voltage (around 100 volts) passing through the load and the condition remains as such till normal voltage level attains.

The last sentence is absolute RUBBISH.
Let's look at the 5k 10 watt resistor.
Here are the facts:
If any device (called a LOAD) is connected in series with a 10 watt resistor, the maximum wattage that can be delivered to the combination is 10 watts.
This is the first fact you have to remember.
The second fact is this: When you connect a LOAD, the wattage delivered to the combination DECREASES.
In other words, if you add a 100watt globe as the load, the wattage delivered to the combination will be less than 10watts TOTAL. The globe will never illuminate.
In fact the total wattage delivered will be 9 watts.
If you add a 1,000 watt radiator as the load, the total wattage will be about 9.9 watts.
The mathematics is very complex but if you add another 5k 10watt resistor, the total wattage will be 5watts delivered to the combination and each will dissipate 2.5watts.
Professor D.Mohankumar's talk about dropping 100 volts depends on the wattage of the load and a 5k 10watt resistor will drop half the supply voltage across it and half across the other 5k 10 watt resistor. But as you can see, the dissipation becomes 2.5watts.
Now you can see how senseless it is to use a 10watt resistor to drop the supply voltage.

The circuit MAY work but it will be very difficult to set the trigger voltage via the 1k and 22k pot.
The circuit is trying to detect 20v increase on 240v and this is 10% change. The 22k pot is wired as a variable resistor and all the adjustment will be at one end of the pot. You will not be able to adjust the pot accurately as the base is tied to the 1k resistor.

The circuit is anther failure of Professor D.Mohankumar.

Here's a disastrous circuit from Professor D.Mohankumar
It's an automatic porch light.



The current from the bridge will be about 70mA and this will appear across the 1M resistor. The voltage from the bridge will be 320v because the 1M will not have any effect in reducing the voltage.
It works like this:
Suppose the 1M is replaced with a 100 ohm resistor placed directly across the output of the bridge.
The voltage developed across the 100R, (when 70mA is available from the bridge) will be:
V=IR = 0.07 x 100 = 7 volts.
The load resistor has to be 100 ohms to load a 105 (1u) capacitor-fed power supply.
If the capacitor is replaced by 100n (104) the load resistor can be increased to 1k and the output voltage will be 7v and the current will be 7mA.
Professor D.Mohankumar has no idea how a capacitor-fed power supply works and he should not be putting these dangerous circuits on the web. **A little knowledge is a dangerous thing**.

HOW THE CAPACITOR-FED (TRANSFORMERLESS) POWER SUPPLY WORKS

You should also go to our article: THE POWER SUPPLY Page2, where we cover the capacitor-fed power supply in more detail.
There have been a number of badly-designed capacitor-fed power supplies on the web due to a lack of understanding of how they work.
Here is a simple explanation:
Firstly we consider just two components - the feeder capacitor and the bridge. These will convert the 240v AC to a set of pulses that will have a height (peak) of about 240 x 1.4 = 330v.
This value is measured from the
The value of the capacitor is not important. The output will always be the same (330v). The only difference is the current capability of the output. It will be 7mA for each 100n of the feeder capacitor.
We now add the STORAGE CAPACITOR. This capacitor will remove the "dips" in the output and produce a voltage that will be close to the peak value.
We now add the LOAD. The load is responsible for producing the output voltage.
This is how it works:
Suppose the load is 1k and the feeder capacitor is 100n. The capacitor will deliver 7mA and the voltage developed across the 1k resistor will be: **V=IR**

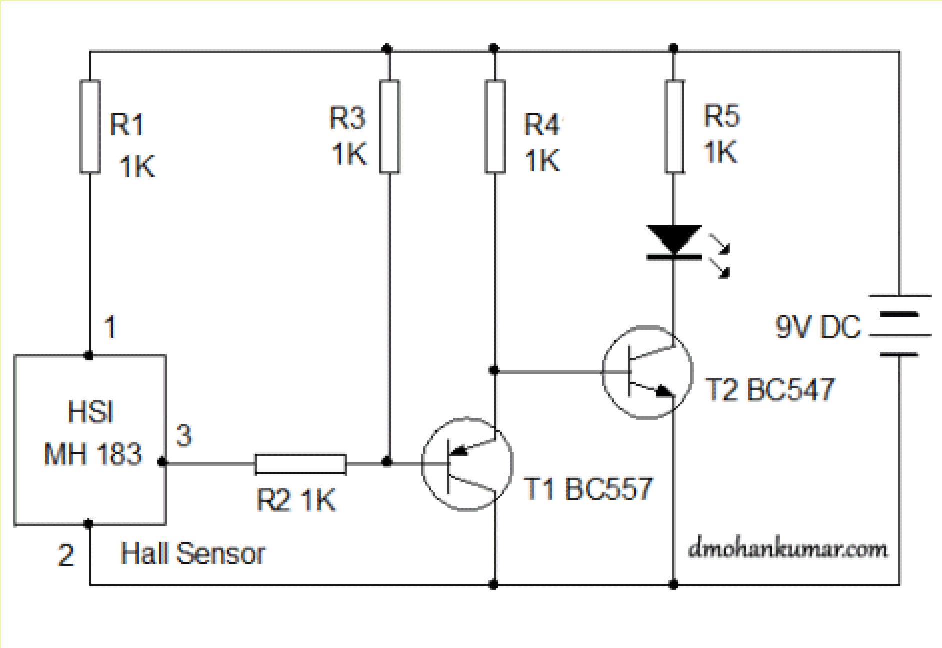
V= 0.007 x 1,000 = 7 volts

If the capacitor is 1u, the voltage developed across the 1k load will be 0.07 x 1,000 = 70volts.
One point to note is this: If the load is removed, the output of the power supply will rise to 330v and blow-up the electrolytic.
In the circuit above, the load is 1M and if you use our mathematical reasoning, the voltage across it will be 0.07 x 1,000,000 = 70,000volts!!! Clearly the 1M is out of range to provide any voltage-dropping feature.

The biggest mistake with a capacitor-fed power supply is to think the feeder capacitor "drops" the voltage. This is not true.

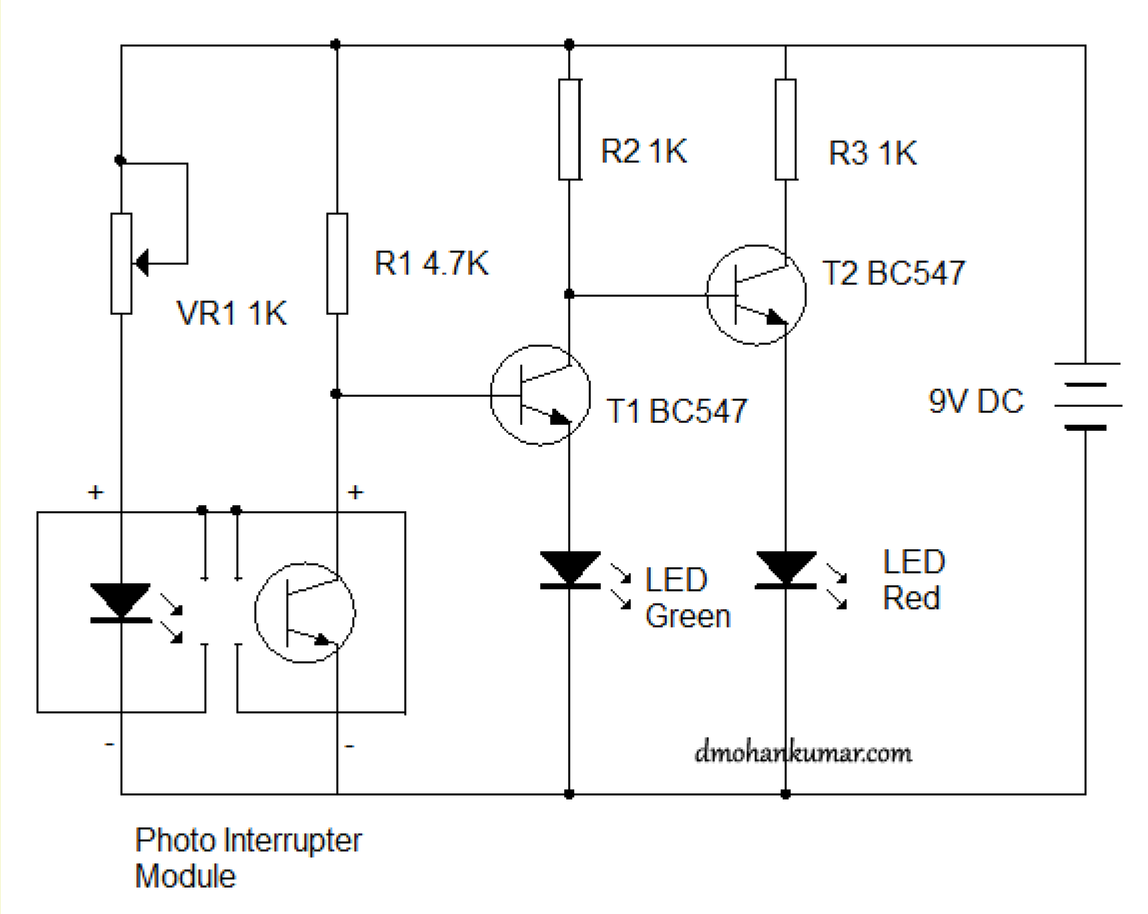
One side of the capacitor see the 240v AC of the "mains."
The voltage on the other side is determined by the current flowing through the LOAD and the resistance of the load.
The feeder capacitor DOES have an effect on the voltage developed across the load but thinking the feeder capacitor "drops the mains voltage" will get you into a lot of trouble.

Professor D.Mohankumar must be the WORST electronics engineer I have ever come across. Here is another of his untested circuits:

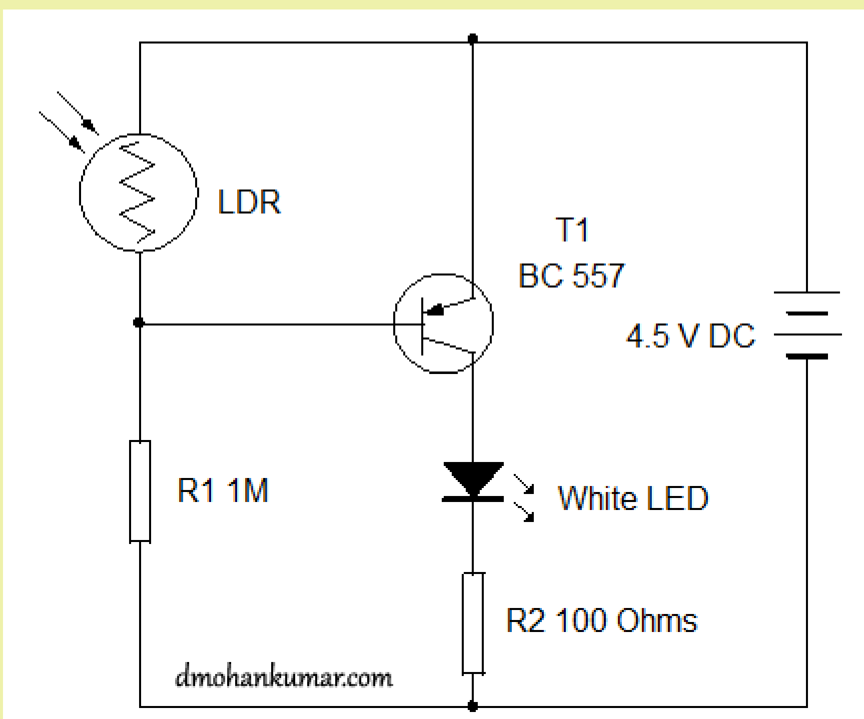


The LED will never go out.
The two 1k resistors on the base of the BC557 will produce half-rail voltage when the Hall Effect device turns ON.
When it turns ON the output goes LOW and pin 3 will have about 0.2v on it.
If we remove R2, the base of the BC557 will have 0.2v on it when the Hall Effect device detects a magnetic field.
The emitter will be 0.6v higher than the base and it will have 0.8v on it.
This means the BC547 will see a minimum of 0.8v and the transistor will remain "active."
This means the circuit will never allow the LED to turn OFF.
Another very badly designed circuit that have never been tested and makes Professor D.Mohankumar an idiot.
I say this because he has been putting these worthless circuits on the web for over a year and I have notified him of each and every fault.
Not once has he had the decency to remove the faulty circuit or make any corrections.

Professor D.Mohankumar is still putting his faulty circuits on the web without testing them.
This is circuit will not work. The 1k pot will blow up the infrared LED if it is turned fully clockwise.
And the second fault is the red LED will never go out.
Let's look at why:
When T1 is not conducting, you can consider it is out-of-circuit and T2 illuminates the red LED via R2 pulling the base of the transistor HIGH, turning on the transistor and the 1k in the collector allows about 7mA to flow and illuminate the LED.
But when the first transistor turns ON, the green LED will illuminate and it will produce a characteristic voltage across it of about 2.3v. The voltage across the collector-emitter junction of T1 will be about 0.2v, making a total of 2.5v on the base of T2. The emitter of T2 will be 0.6v lower than the base and it will provide a voltage of 1.9v
The red LED will turn ON when the voltage is above 1.7v and this means the red LED will always be illuminated.
It's just another badly-designed circuit that should not be on the web.



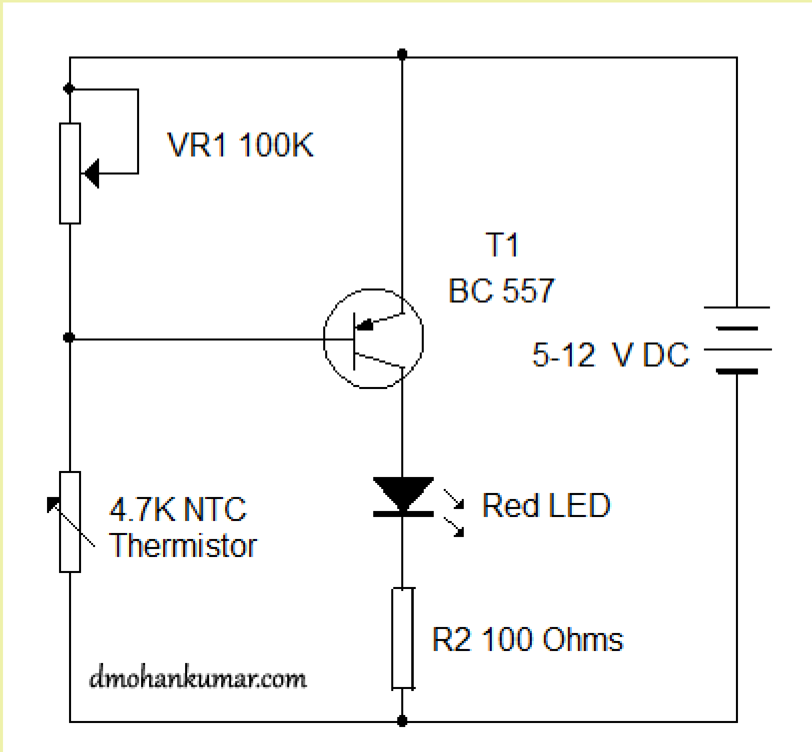
Another untested Professor D.Mohankumar circuit:



The 1M resistor on the base of the transistor will not turn the LED on.
Look at the circuit this way: The 1M resistor will allow 4 microamps to flow into the base. The transistor will amplify this current 300 times (the gain of the transistor.) This means the maximum current through the emitter-collector leads will be 1mA.

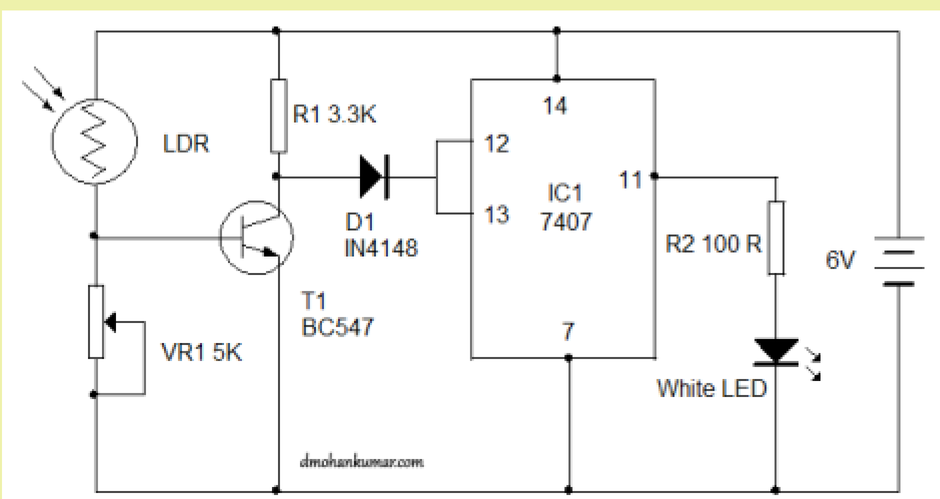
It's simple enough to test a circuit before putting it on the web. Professor D.Mohankumar constantly refuses to test anything before making a fool of himself.
You can learn a lot from the stupidity of others.

Another untested Professor D.Mohankumar circuit:



It will be very difficult to adjust the 100k pot to suit the change in resistance of the NTC thermistor. Just build it and see what I mean.

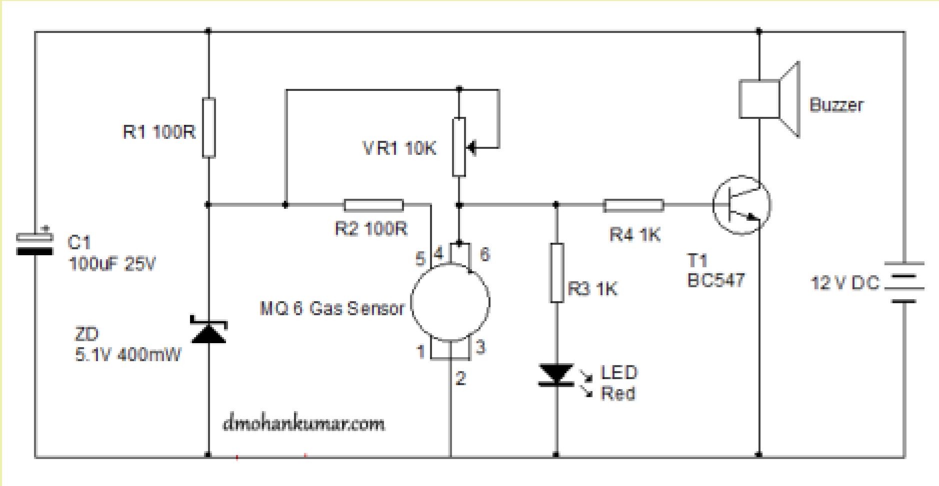
Another untested Professor D.Mohankumar circuit:



The 7407 IC is an open-collector device and the outputs will not source any current. The load must be placed between rail and output. None of the pin numberings match up with a 7407. The chip-number should be 7408.
The other problem with the design is the diode on the input to the chip.
This diode will not pull the inputs LOW.
The inputs on this chip float HIGH due to internal resistors on the inputs and this circuit will not work AT ALL.
It's another failure.
This makes it 100% fail for all the circuits Professor D.Mohankumar has put on his site in the pasts few months.
It goes to show that you cannot "dream up" a circuit and say it will work. There are a lot of technical points that

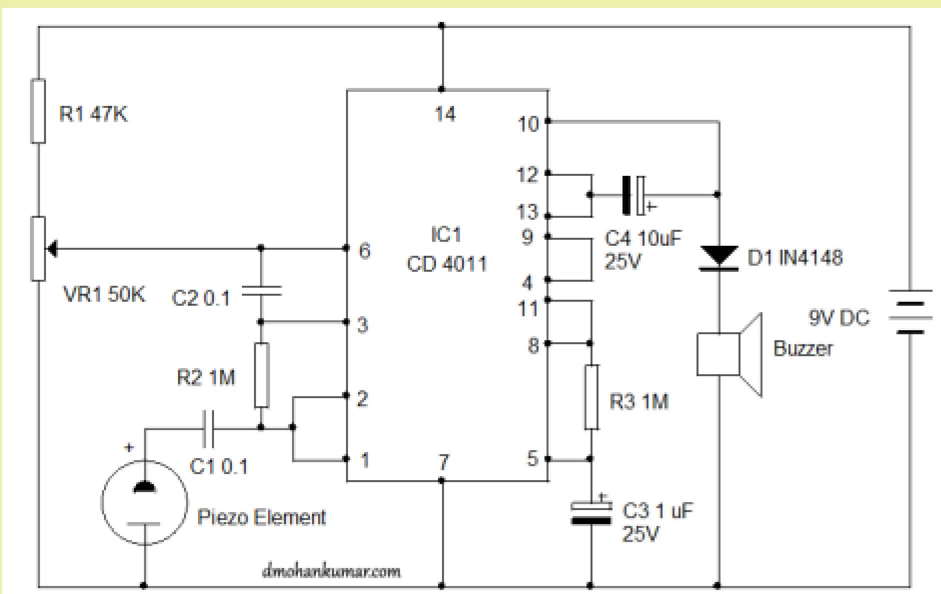
must be checked before releasing a circuit. Simply testing the design is a starting-point.

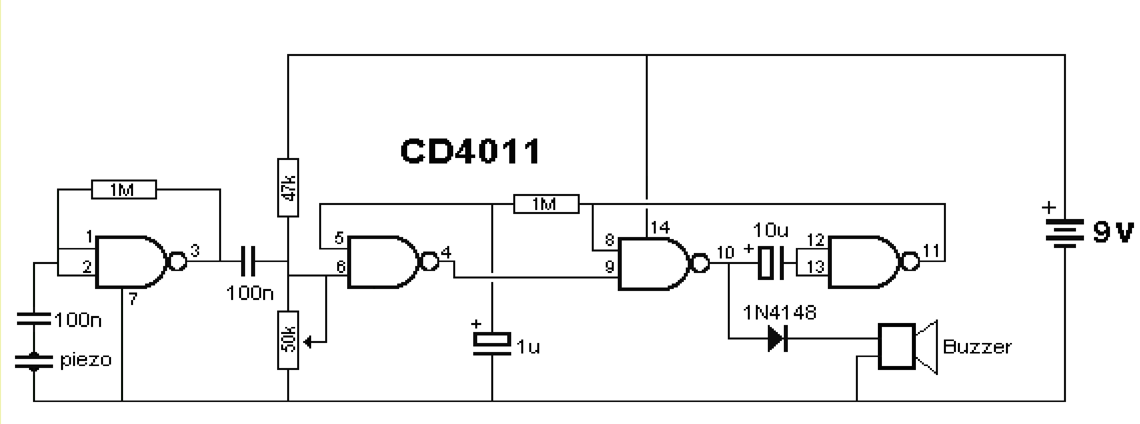
Another untested Professor D.Mohankumar circuit:



This is a GAS sensor circuit. It will not work because the gas sensor takes 150mA to heat up the sensing chamber.
150mA flowing though a 100R resistor will drop V=IR = 0.15 x 100 = 15v
The gas sensor will see NO VOLTAGE !!!!!!
This is obviously another untested circuit from a technician who knows nothing about electronics.

The faults with this circuit are not obvious until you redraw it using NAND gates:



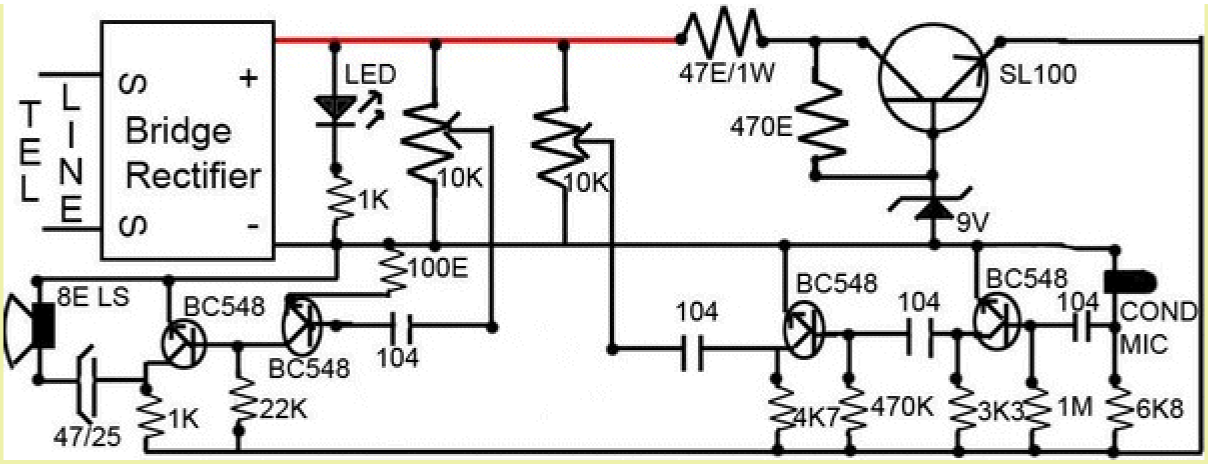


The first problem is the first gate. It produces an oscillator (very similar to a Schmitt Trigger Oscillator). (refer to Schmitt Trigger Oscillator section on Talking Electronics website - see **100 IC projects**). The output will always be producing a square-wave waveform equal to rail voltage and when the piezo is tapped, the waveform will change. However the circuit is not capable of detecting only a tap on the piezo diaphragm and thus the circuit will not work.
The 100n in series with the piezo is not needed as the piezo is equivalent to a capacitor of about 22n.
The next major fault is the lack of a charging-resistor on pins 12/13 to charge/discharge the 10u. Without this resistor the timing of the circuit is unknown.
There may be more faults. . . .
The purpose of the 1N4148 diode is unknown.
Build the circuit and prove it DOES NOT WORK.
Another untested circuit from Professor D.Mohankumar.

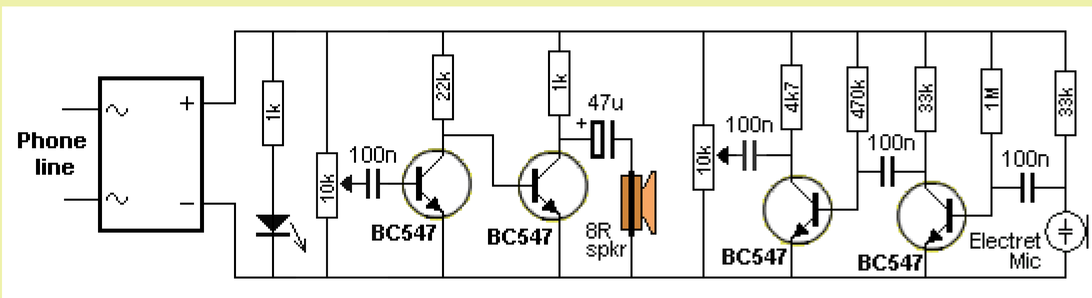
A little knowledge is dangerous thing.

Loudspeaker Circuit For Telephone

This circuit is a handsfree telephone receiver system. It doesn't have a dialing circuit so it's not a total phone replacement circuit, but it's a loudspeaker system (i.e, phone receiver).
Apart from the fact that the circuit drawn up-side-down, some of the components are not required. The circuit has not been tested but since it comes from India, you can be sure it will be a very poor performer.
However it is the concept of connecting items to the phone line that I want to address.
The phone line is not like a normal 50v power supply.
It has very little current capability.
When a 1k resistor is placed on the line, the voltage drops to 22v. With 470R the voltage drops to 12v.
As you can see, the circuit has a number of resistor across the phone line: 1k plus LED, 10k, 10k, 6k8, 3k3, 4k7, 22k and 1k.
The combined value of all these is less than 470R and the voltage will drop to about 10v. This means the the SL100 transistor, 9v zener and accompanying resistors are not needed.
The base of the first audio stage (the section that drives the speaker) does not have a bias resistor and this will produce poor results.
Because there is no 100u electrolytic on the power rail of the audio stage, it is difficult to know how the amplifier will drive a low impedance speaker. The 1k load on the output transistor will only allow 9mA to flow through the speaker.

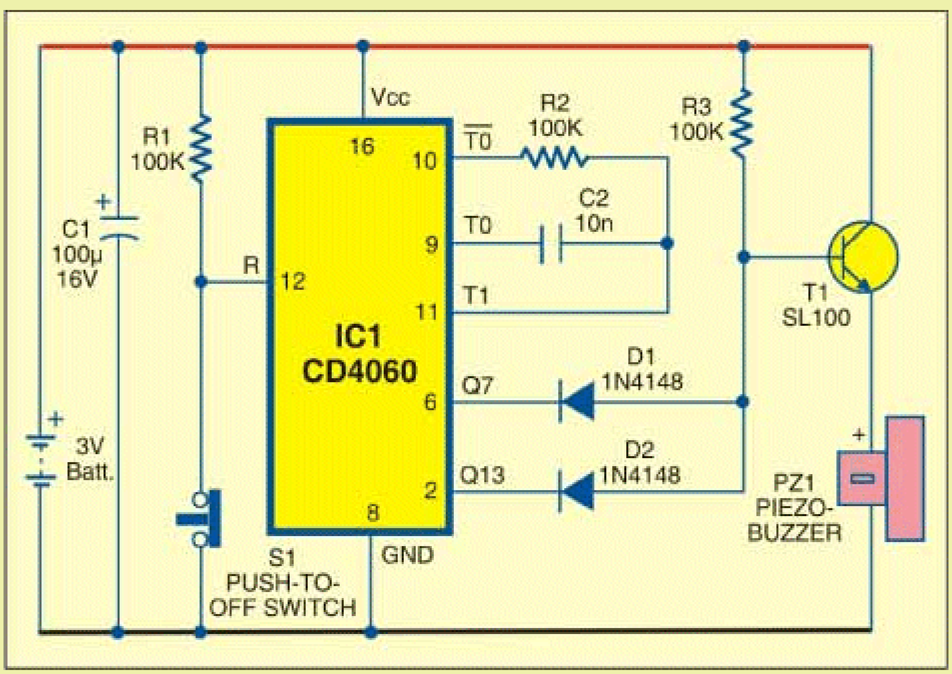


Here is the corrected version with the circuit, drawn so it can be understood. The circuit has not been tested and may suffer from motor-boating and/or feedback problems:



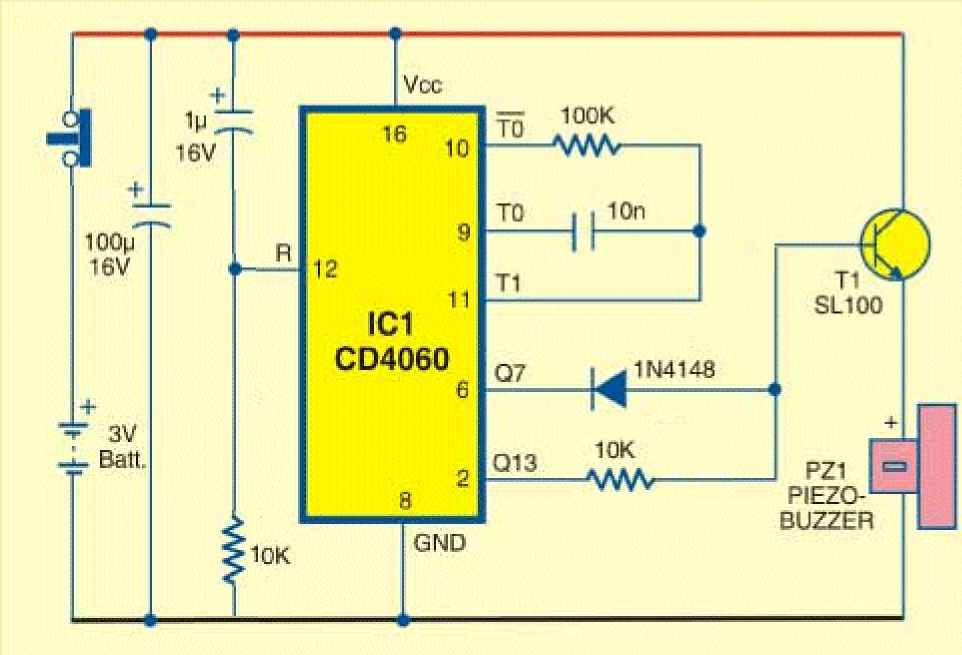
OPEN DOOR ALARM

This circuit beeps if a door is left open for more than a few seconds.
It is one of the worst designs I have seen from India.
The circuit is consuming current when doing nothing and the battery will last only a few months.



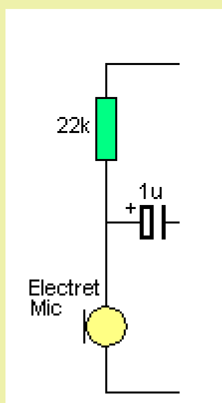
A better design is to place the switch on the supply so the circuit is not consuming current when it is not activated.

The other change shows how to correctly use the outputs of the chip to activate the piezo buzzer.
The door pushes the switch open when the door is closed and the circuit consumes no current.



IMPROVED CIRCUIT FOR DOOR ALARM

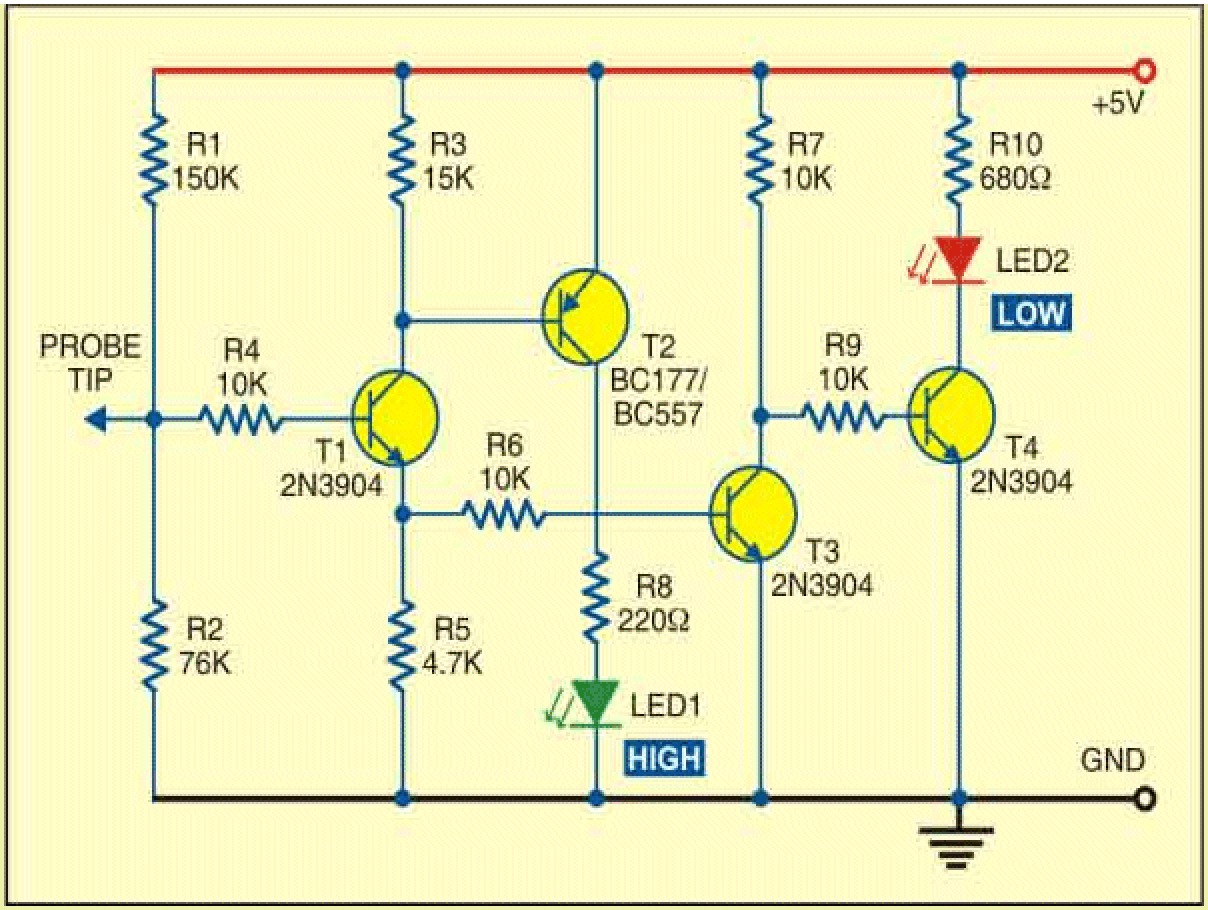
A reader on an electronics forum thought the resistor and capacitor in the following circuit created a TIME CONSTANT.



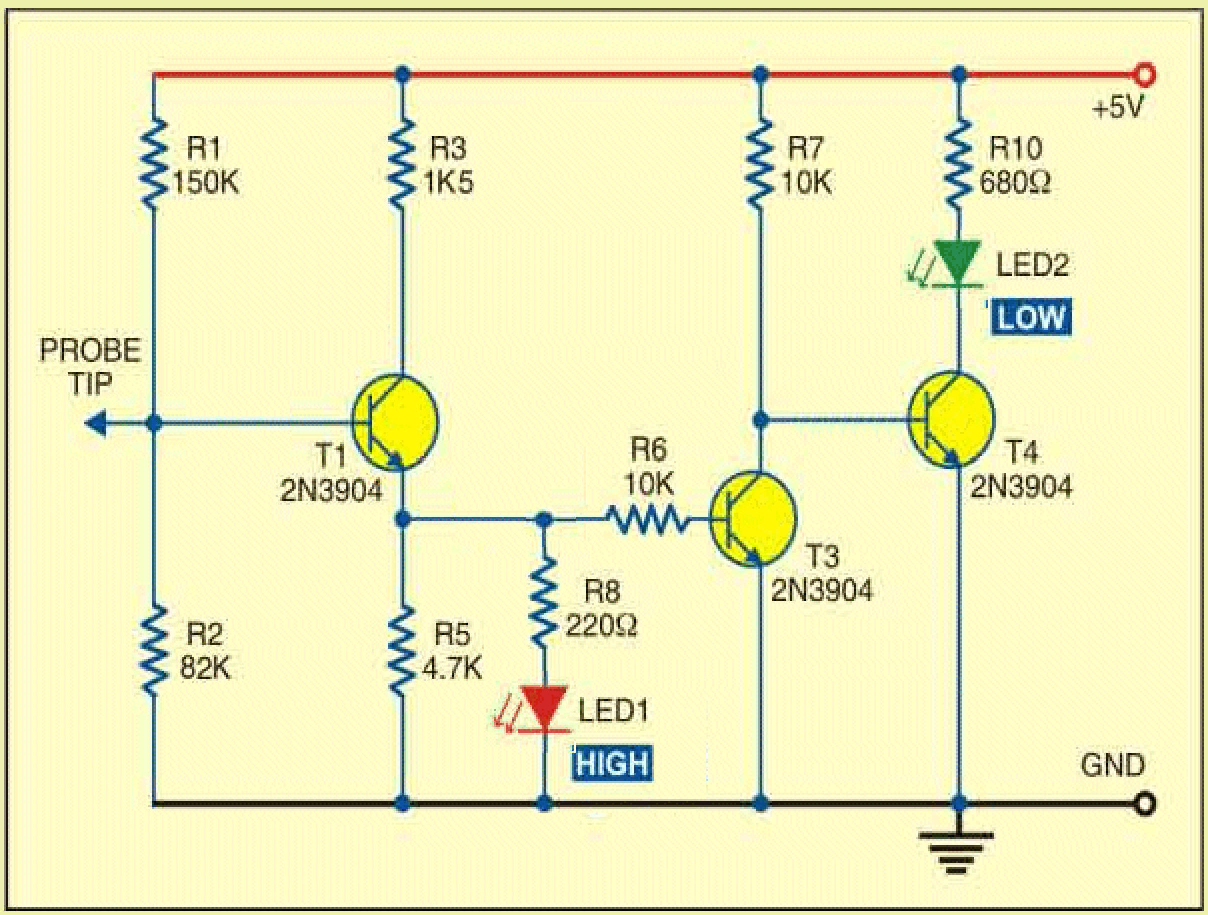
The resistor and capacitor in the circuit above DO NOT act as a TIME CONSTANT. A time constant arrangement must not have a LOAD connected to the join of the two components.
At the join of the two components in a time constant CIRCUIT, is a DETECTING circuit that must not load the circuit AT ALL. The detecting circuit detects when a certain voltage has been reached and if it puts a load on the circuit, the timing will be altered.
In the circuit above, the 22k allows the electret mic to take about 0.5mA. This is the ideal current for the FET inside the microphone. If the current is increased, the microphone will become more sensitive but some microphones will start to produce background noise similar to frying bacon and eggs. The 1u on the output of the circuit allows very low frequencies to the transferred from the microphone to the next stage of amplification.

TTL LOGIC PROBE

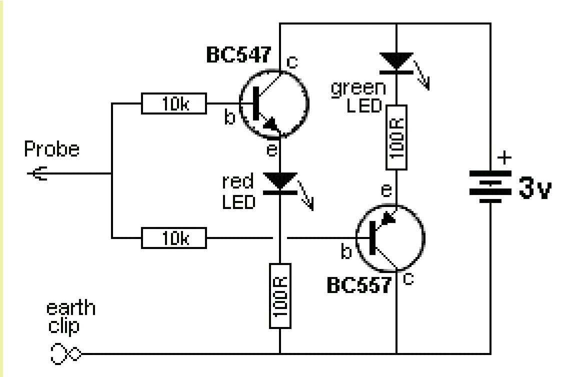
Apart from the fact that the following circuit will not work until the 15k resistor is replaced with a 1k5, it contains a number of unnecessary components and a difficult to obtain 76k resistor.
The HIGH LED should be red and the LOW LED should be green.
But the biggest mistake is the complexity of the circuit.



It can be simplified to:

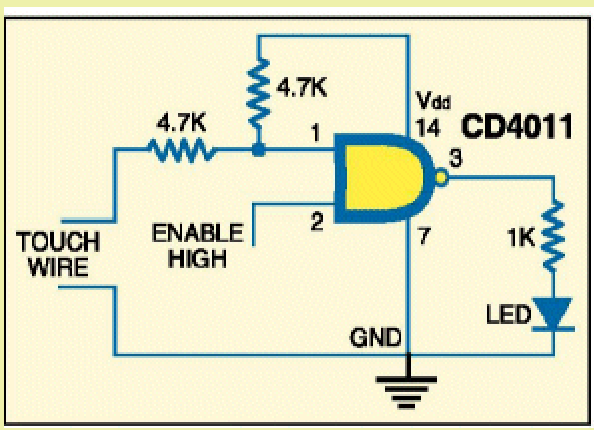


But if you want the simplest circuit, here is the answer:



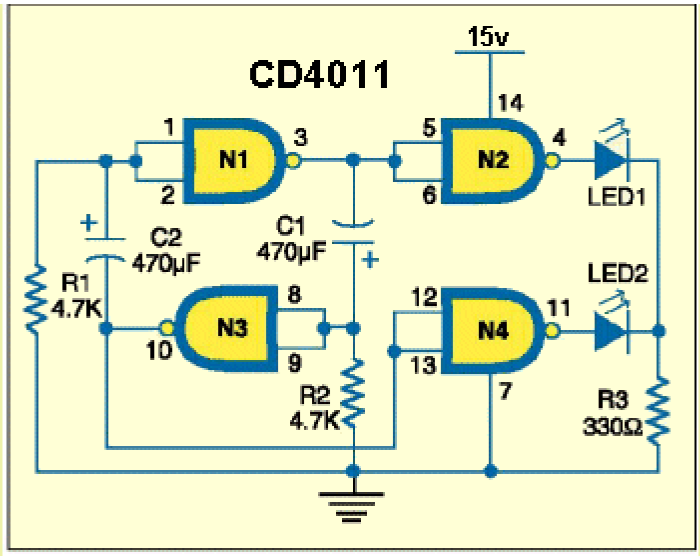
Here are some glaring mistakes from a recent issue of **Electronics For You** magazine, an Indian publication reaching 40,000 or more electronics hobbyists.

The author has used TTL concepts with CMOS technology.
TTL Chips were the first to be developed and the inputs required a small current to activate the gate. To deliver this current, the associated input resistors needed to be about 4k7.
CMOS devices were then developed and the input current was less than a microamp. Input resistors could be as high as 1M to 4M7. The corresponding capacitor-values for oscillator circuits changed from 470u to 100n to 10u.

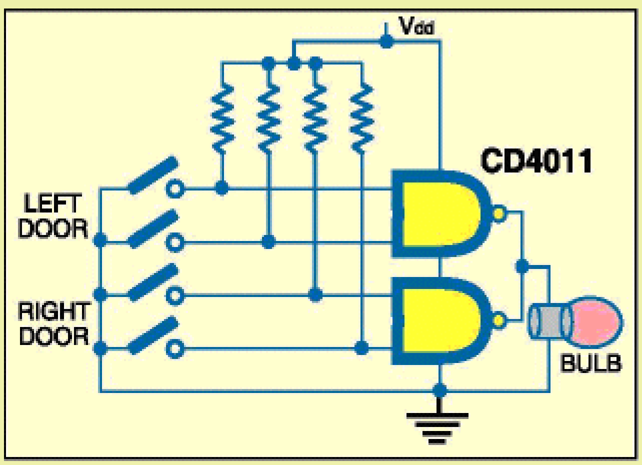


In the circuit above, the resistance of a finger across the touch wires will NEVER change the state of the gate. The 4k7 resistors must be increased to 470k to 4M7.
The reason is this: Your finger represents a resistance of about 100k. Your finger and the top 4k7 creates a voltage divider for input pin 1. The gate will change when the voltage on the input is slightly less than half-rail-voltage. You will never be able to press hard enough to create a resistance of 4k7. That's why the resistor must be 100k or higher.

It is not clear what the circuit is trying to do as the **enable line** of the gate is floating. The chip will pick up hum from this wire and make the LED flicker.

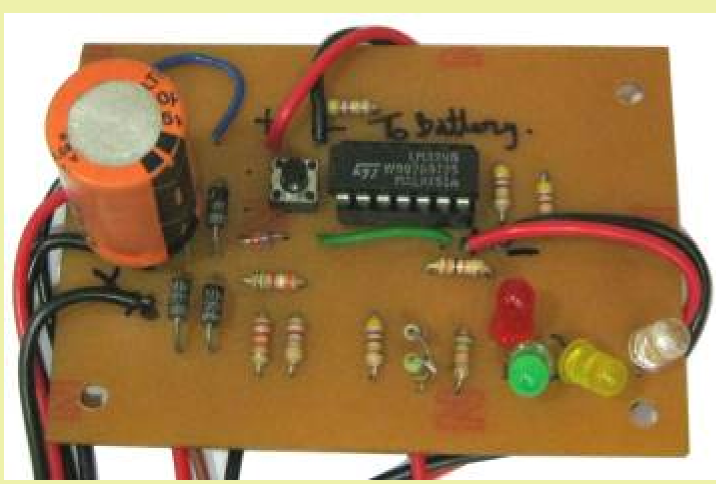


The resistors in the circuit above should be increased to 470k and the capacitors can be decreased to 100n to 10u. This shows you know what you are doing and understand CMOS designs.
Another fault is the connection of the LEDs to a common current-limiting resistor. This allows a reverse voltage to appear on the non-illuminated LED and the 15v supply may damage the LEDs. Most LEDs will only tolerate 7v reverse voltage.



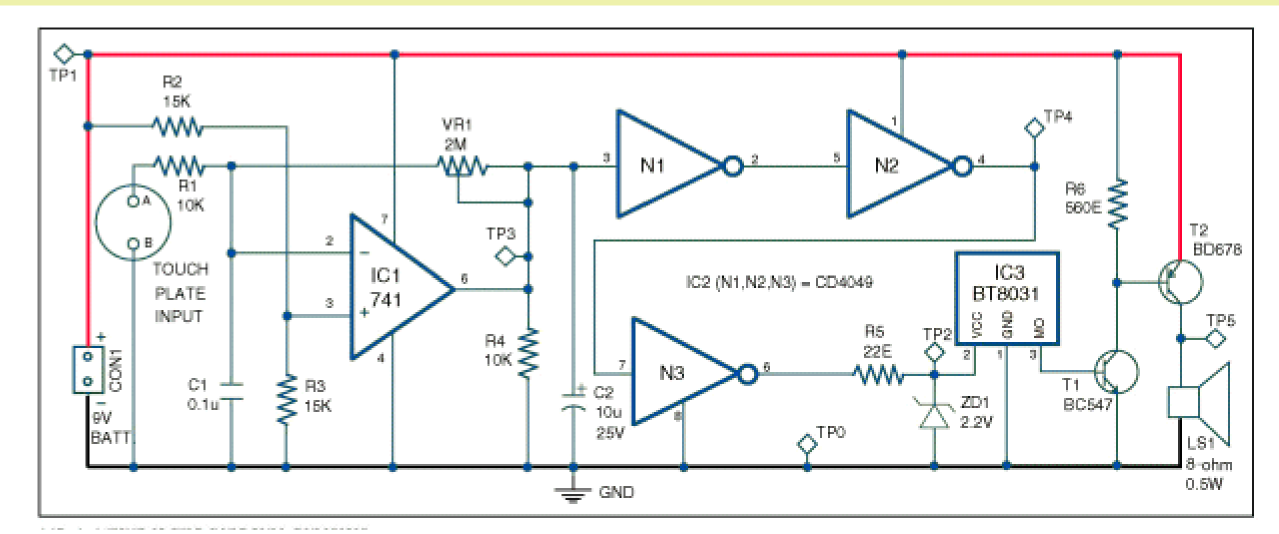
The outputs of gates must NEVER be tied together like this as they will be "fighting each other."
The chip can only deliver 10mA and will not be able to illuminate a globe.

Look at this PC board from an Indian magazine:

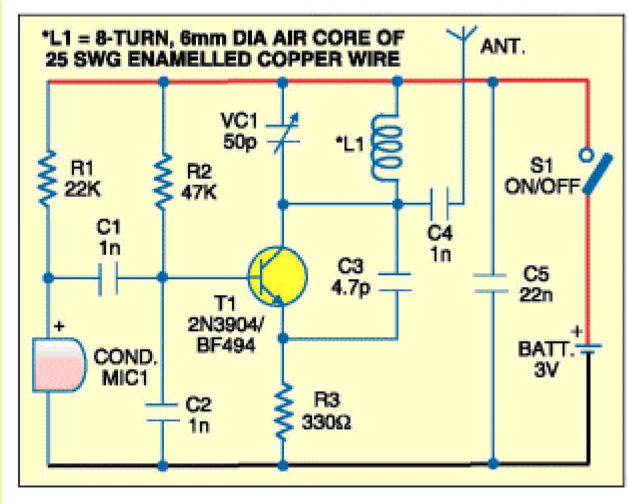


It's a perfect example of how **NOT** TO DESIGN A PC BOARD.
The LEDs are bent over each other.
The leads are connected to all parts of the board.
The push button is in the centre of the board.
One lead is UNDER the electrolytic.
No overlay. Hand-written words on the board.
Resistors joined together.
This is a kit sold by one of India's leading hobby magazines!

DING DONG DOORBELL
Apart from the fact that the circuit is overly-complex and contains difficult-to-obtain components, it also has a major fault. I am not suggesting you build it, as the Ding Dong chip BT8031-02 is difficult to get.
This is just a study in "HOW NOT TO DESIGN A CIRCUIT."
The CD4049 contains 6 identical gates and one of them could be used in place of the 741 op-amp.
The BT8031 is a melody chip and the exact number for Ding Dong is BT8031-02. This chip will operate from 2v to 5v and the 2.2v zener could be replaced by two red LEDs.
The major fault is the connection of the collector of the BC547 to the base of the BD678 Darlington transistor. When the BC547 transistor turns ON, the collector is effectively connected to the positive rail via two junctions in the BD678.
If the base receives 0.5mA from the melody chip, the collector-emitter current will be 100mA, if the gain of the transistor is 200. If the gain is higher and the base receives more current, the flow could exceed the rating of the transistor.
It is simply a bad design to connect the two transistors like this.
The base of the BD678 only needs a current of about 0.5mA to drive the speaker and the additional current-flow is WASTED CURRENT.
A BD679 (NPN Darlington) could be used to replace both the BC547 and BD678.



FM BUG
Here is a circuit from a recent Indian Magazine. It's an FM Bug, and although the circuit looks to be correct, there are a number of underlying faults.
The major fault is the poor operation of the circuit. A single transistor deign does not provide enough audio amplification to allow the bug to pick up faint conversation. It' sonly good for a hand-held microphone where you are talking directly into the microphone.
But the major fault is the 1n on he output of the microphone. The capacitive reactance of this at say 500Hz will be about 200k. Very little of the signal developed by the microphone will be delivered to the oscillator.
The only other problem is the 4p7 feedback capacitor. At 3v, some transistor will fail to oscillator and the capacitor needs to be 10p.
The 1n on the antenna serves no purpose and the 50p air trimmer should be a lower value and have a fixed 39p across the coil. An air trimmer drifts a lot more than a capacitor and that's why it should be kept as small as possible.
See the article: **Spy Circuits** for information on how to correctly design FM transmitters.

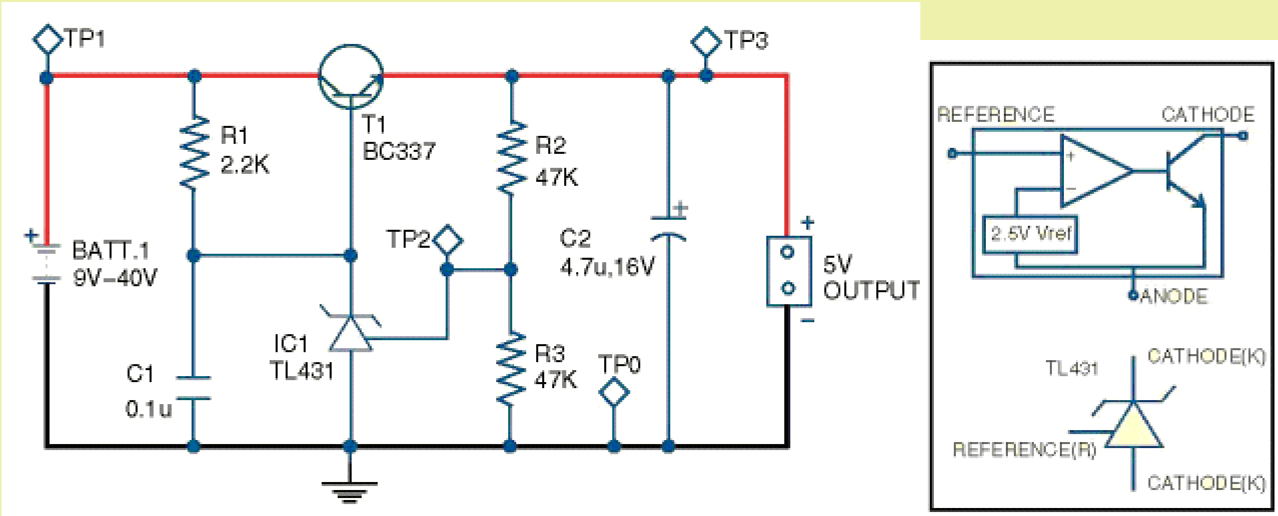


5v Regulator

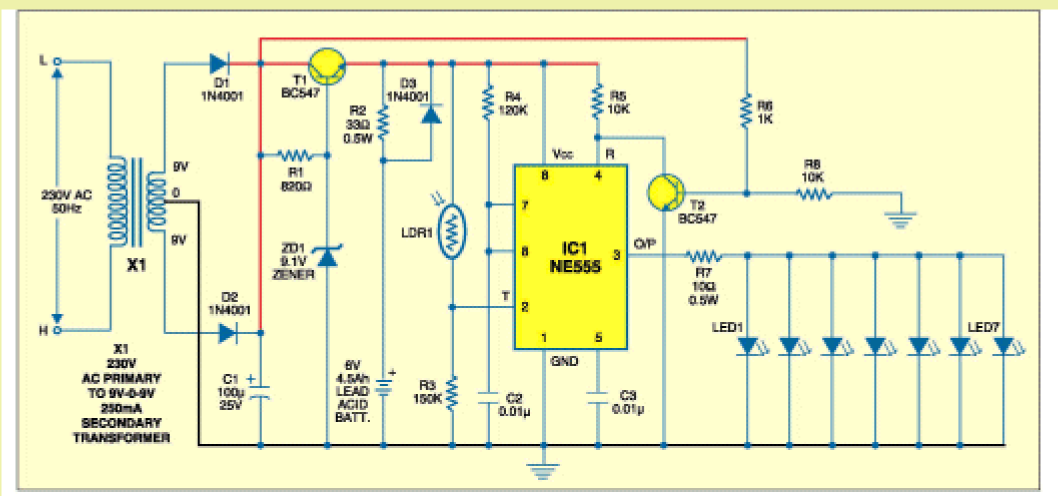
There is nothing wrong with the circuit, but the text has faults:

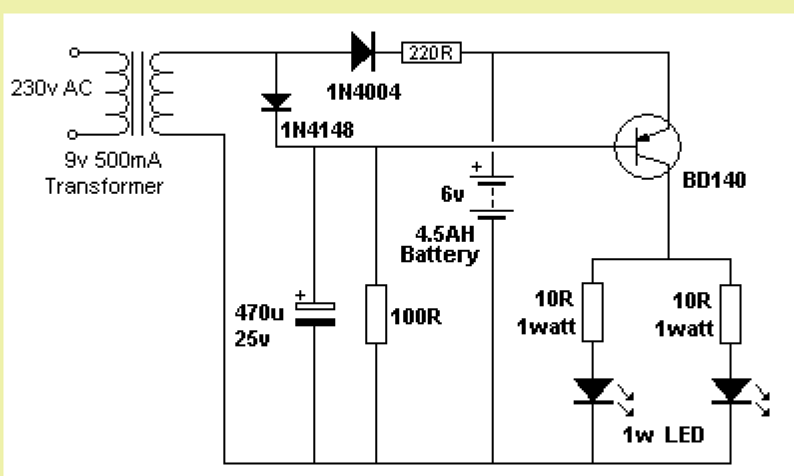
When the reference voltage of IC1 reaches 2.5 volts, its cathode sinks, (what does this mean??) causing the output from BC337 to drop. The moment the voltage at reference pin falls below 2.5 volts, IC1 allows transistor T1 to charge capacitor C2 to 5 volts. The no-load current of this circuit is in micro-amperes, whereas for a standard regulator it is in milli-amperes. This proves that it can significantly reduce power losses and hence improve efficiency, making it suitable for battery-operated circuits.
Working of the circuit is simple. It provides constant 5V output from an unregulated 9-40V DC input. The input power can be from a DC adaptor or a 9V/12V/24V external battery.

The writer obviously does not know what he is talking about. The output of the BC337 never "drops." The voltage simply rises and never increases above 5v. Here is what is call a "slow-motion" description to show how everything works - the "write" has the completely wrong approach:
Suppose the input voltage rises from 0v to 9v.
This will make the discussion easy.
As the voltage rises on the circuit, the transistor passes this voltage to the 4u7 electrolytic. Resistors R2 and R3 form a voltage divider and when the voltage at their join reaches 2.5v, IC1 turns ON and the voltage on the cathode is not allowed to rise any further.
The voltage on the cathode happens to be 5.6v in this circuit and this makes the output of the BC338 5v.
The voltage across R1 will be 9v minus 5.6v = 3.4v   The current through the 2k2 resistor will be 1.55mA. This is clearly not microamp current. The author never bothered to test the circuit.
The IC can be replaced with an ordinary 5v6 zener diode. A zener is easier to get and cheaper.
You will notice the pinout of the TL431 shows cathode for both leads. This is obviously a mistake.
The transistor is called a PASS TRANSISTOR. The IC is called a SHUNT REGULATOR.
The theoretical maximum current for this circuit is about 200 times more than the base current. (If we assume the gain of the transistor is 200).
If the base current is 1.5mA, the max output current will be 300mA. The voltage across the transistor will be about 4v and the losses will be 1,200mW. The transistor will have to heatsinked as it can only dissipate about 500mW.
If the input is unregulated, the circuit will reduce the ripple by a factor of 200. You can even use a string of LEDs to create the 5v zener.



Here's an over-designed circuit.
You don't need a smoothed, regulated circuit to charge a battery. In fact pulsed current works best as it dislodges the built-up sulphate deposits on the plates. The output of the regulator is 9.1 - 0.7 = 8.4v The battery will generate a "floating charge of 7.5v The current through the 33R resistor will be 27mA.
There is NO SKILL in over-designing a circuit. The skill is to produce a simple circuit. I have already mentioned a number of products that have been simplified over the years and this represents REAL SKILL. The second circuit does the same thing with a lot less parts. Generally, when the electricity "goes out" you will want the emergency light to come on, whether it is day or night as the light will be placed in a fairly dark location. The LDR feature is not needed.





This circuit will illuminate two 1watt High-bright LEDs when the power fails. The charging current is about 20-30mA. It will take about 7 days to charge the battery and this will allow illumination for 5 hours, once per week.
A charging current more than 150mA will gradually "dry-out" the battery and shorten its life.
If the project is used more than 5 hours per week, the charging current can be increased.
The 220R charging resistor can be reduced to 150R or 100R (1watt). A 4.5AHr battery can be theoretically constantly charged at 450mA without it generating excessive gasses via the safety plugs. But any more than 150mA (when the battery is fully charged) will electrolyise the water (turn it into H_2 and O_2) and dry the battery out.

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